Radio, Electronics and Communications

FORMERLY "RADIO & ELECTRICAL REVIEW" — WIDELY KNOWN SINCE 1946 AS "R. & E."

MPL

In This Issue . . .

- A Transistorised Communications Receiver
- A New Broadcasting Transmitter
- Transistorised "Grid-Dip"
- Aeronautical Expert Talks on Noise
- Future of Telecommunications
- Latest News from Electronic Industry

PUBLISHED MONTHLY IN THE INTERESTS OF THE N.Z. ELECTRONICS INDUSTRY FOR ALL LEVELS, FROM PROFESSIONAL TO AMATEUR.

VOLUME 19 NUMBER 6

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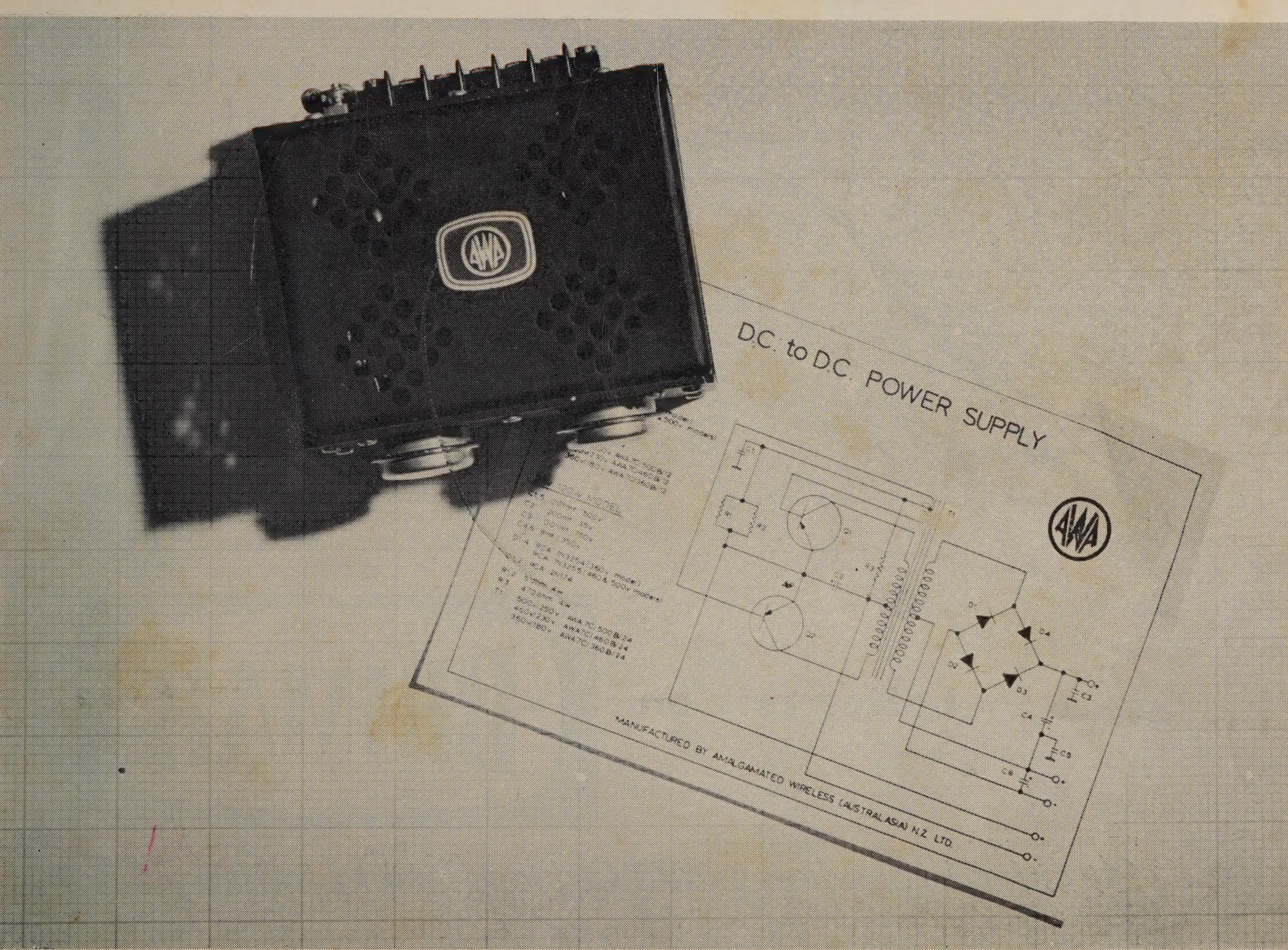


AWA

AWA TRANSISTORISED DC—DC POWER SUPPLY

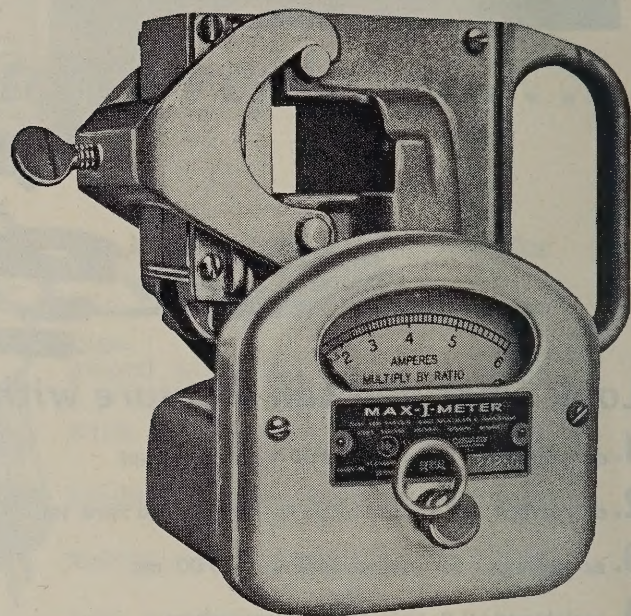
See Page 3

ENQUIRY CARD AD. 3

HD MAX-I-METER

What It Is–

The MAX-I-METER is a completely weatherproof combination of a multi-ratio split-core transformer and a thermal type maximum demand ammeter. Practically every utility in North and South America now use the MAX-I-METER for checking distribution transformer maximum loading.



What It Does–

The MAX-I-METER when clamped on an electrical conductor and left in position for 30 minutes or longer, accurately measures and records the maximum current flowing through the conductor.

How It Is Built–

The MAX-I-METER is made in a number of sizes with the window opening ranging from $1\frac{3}{4}$in. to $3\frac{1}{2}$in. The flexibility of the unit permits its installation on primary conductor cables as well as conductors that are insulated with standard line hose.
The lowest ratio possible on a split core current transformer is 40/5 or 8/1. To obtain this low ratio, the transformer core must have a considerable amount of silicon steel. To offset this weight, the frame housing and cover are made of aluminium. The transformer core is made from the lowest core loss steel available. The instrument is a rugged unit, capable of withstanding a tremendous amount of abuse.

Simple To Use–

The MAX-I-METER can be installed by any linesman. No previous experience is needed. It can be installed during the working day, left on the conductor as long as necessary, removed on another working day and transferred to some other location in need of checking. The flexibility of the MAX-I-METER enables the operator to check many sizes of transformers. This is accomplished by merely changing the ratio of the split-core transformer. The maximum demand indication pointer is reset by simply turning the cover reset knob.

Most MAX-I-METER models have enclosed secondary coils for maximum weather protection. The enclosed coils have four ratios, with the ratio leads terminating at a plainly marked terminal board. This permits the operator to make quick and correct ratio changes. The ratio leads from the transformer to the ammeter are short, flexible rubber-covered wire leads, with a simple positive connector. These short ratio leads can be disconnected from the transformer and long leads (20ft.) substituted for connection to a graphic ammeter if desired.

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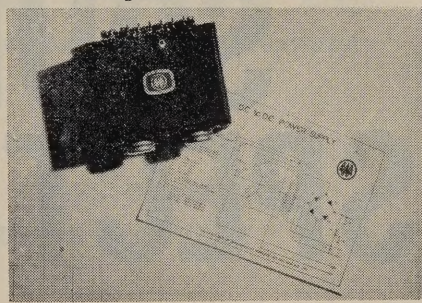


The history of radio and electronics has always been dominated by the need for reliable power supplies. As the vibrator replaced the HT accumulator bank, so now A.W.A. have harnessed the transistor in a supply with proven reliability and more than 85% efficient.

Available in 12 and 24 volt input models, with a range of output voltages, they deliver 120 watts in continuous operation.

Developing even such a small supply demands a great deal of research and engineering effort. Nothing can be left to chance. Attention must be paid to the corrosion-resisting properties of the case and screws as well as to the properties of transformer insulation. All must be tested, re-tested, and proven before one unit is sold for use in the field.

The rigid testing and high standard of development exemplified by this power supply are continuous A.W.A. policies applied to all aspects of electronics. It is this planning for the future which guarantees the performance and reliability of all A.W.A. equipment.

FEATURED NEXT MONTH . . .

A D.C. to D.C. Converter

Semiconductors versus Relays

A Power Supply

V.H.F. Aerials

Also . .

New Products

Book Reviews

Serviceman's Column

Circuit and Service Data

Letters from Readers

Sir,

In the July 1962 issue of your magazine appeared an article describing the construction of an automatic enlarger timing switch.

The values of R35 and R36 are not clearly shown and I would appreciate it if these values could be clarified.

J. H. HAYNS,
Tech. Dept.,
Nae Nae College.

The values of R35 and R36 we are told are 1K 5 watt and 1.5K 10 watt respectively. We trust this information will facilitate your construction of this unit and thank you for your inquiry.

—Ed.

Sir,

If there is any advance information relating to the "Corvette" radio-telephone as mentioned in "R & E," Overseas Notebook dated 1/3/64, could an illustrated pamphlet be made available, please?

Perhaps, if a N.Z. agent has been appointed, you could inform me of the name and address so that the required information could be obtained direct.

NOEL L. CAINE,
c/o Dept. of Civil Aviation,
Telecoms Workshops,
Shelly Bay.

We are trying to locate this information for you and will forward it as soon as it comes to hand.

—Ed.

Sir,

From time to time you publish circuits of various radio apparatus. I wonder whether you sell extracts of the circuits as does Radio and Hobbies.

Could you let me know if you do or would a person have to buy a back number.

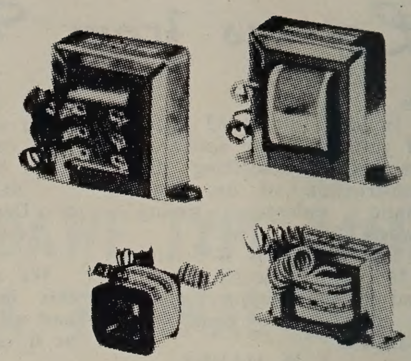
B. E. ADIN,
Nae Nae,
Lower Hutt.

We have been considering publishing a collection of these circuits but to date have not finalised when this will be. At present the only solution is to buy the back numbers of which we have a limited stock available.

—Ed.

ENQUIRY CARD AD. 8

OUTPUT TRANSFORMERS to your requirements by ATC



We Manufacture many types of Output Transformers for New Equipment and Replacement Repair Work.
WINDINGS AVAILABLE FOR OP1-14 and OP18-22 INCLUSIVE

Type No.	Wattage	Impedance Ratio	Bobbin Size	Colour Code	Mounting
†OP1	3	5K/3 ohms	9/16 Square	Red	Clamp
†OP2	3	7K/3 ,,	9/16 ,,	Yellow	,,
†OP3	3	10K/3 ,,	9/16 ,,	White	,,
†OP3 C	3	10KCT/3 ohms	9/16 ,,	White	,,
†OP4	6	5K/3 ,,	¾ Square	Red	,,
†OP5	6	7K/3 ,,	¾ ,,	Yellow	,,
†OP6	6	10KCT/3 ,,	¾ ,,	White	,,
†OP7	6	14KCT/3 ,,	¾ ,,	Black	,,
†OP8	4.5	5K/3 ,,	11/16 x 13/16	Red	,,
†OP9	4.5	7K/3 ,,	11/16 x 13/16	Yellow	,,
†OP10	4.5	10KCT/3 ,,	11/16 x 13/16	White	,,
†OP11	4.5	14KCT/3 ,,	11/16 x 13/16	Black	,,
†OP12	4.5	Universal	11/16 x 13/16	—	,,
†OP13	6	Universal	¾ x ¾	—	,,
†OP14	10W	Universal	⅞ x ⅞	—	,,
OP15	20	5KCT/Univ.	1" x 1¼	—	Side covers & feet
OP16	20	6.6KCT/ ,,	1" x 1¼	—	,,
OP17	20	10KCT/ ,,	1" x 1¼	—	,,
OP21	2W	5K/3	½"	Red	Windings Only
OP22	2W	7K/3	½"	Yellow	,, ,,
OP23	35W	5KCT/Univ.	2" x 1¼	—	Covers & Feet
OP24	35	6.6KCT/ ,,	2" x 1¼	—	,, ,,
OP25	35	10KCT/ ,,	2" x 1¼	—	,, ,,
OP26	15W	Hifi 5KCT/15 ohms	2" x 1¼	—	,, ,,
OP27	15W	Hifi 8KCT/15 ,,	2" x 1¼	—	,, ,,
OP28	15W	Hifi 10KCT/15 ,,	2" x 1¼	—	,, ,,
		ULTRA LINEAR TYPE			
OP29	20W	6.6KCT/15 ohms	2" x 1¼	—	,, ,,
OP30	20	8.5KCT/15 ,,	2" x 1¼	—	,, ,,
OP31	20	10KCT/15 ,,	2" x 1¼	—	,, ,,
		LOW POWER EXTENDED RANGE			
OP32	6W	8KCT/7 ohms	1¼" x ⅞"	—	Clamp
OP33	6W	8KCT/15 ,,	1¼" x ⅞"	—	Clamp
OP34	3W	Universal	9/16 x 9/16	—	,,
OP35	6W	10KCT/15-7.5-3 ohms	¾ x ¾	—	,,
OP36					
OP37 / OP50	8W U/L / 10W stereo	9KCT/15-7.5-3 ohms	⅞" x ⅞"	—	,,

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THIS CHANGING INDUSTRY . . .

It was the Second World War that brought electronics to the fore. Overnight, engineers who had spent their entire careers designing radios and telephone repeaters found themselves inventing radars and computers thus giving new dimensions to the industry of electronics.

Then the war was over and most everyone expected to see progress fall away. It soon became evident, however, that this was not to be the case. First the pent-up demand for radios and television kept the wheels of the industry spinning. Then the innovations of the war itself—radar, sonar, computers, microwave links and the like, began to find new life on the civilian markets of the world.

Before these new markets even matured, the Korean conflict arose and with it the resumption of military electronics activity. Next came the nuclear and space programmes with their tremendous instrumentation needs. So, for the past two decades the electronics industry has been faced with challenge upon challenge, one stimulant after another.

But now the tide is showing signs of a swift and serious turn for the worst, for early this year the U.S. Secretary for Defence, McNamara, announced a 4 billion dollar cut in the Defence Appropriation. Defence expenditure in 1956 in the United States was approximately 15 billion dollars and this rose steadily to 23.5 billion in 1963. Now the new cut is to reduce expenditure to 19.5 billion by 1967. Further, it is predicted that there will be a reduction of 11.5 billion dollars between now and 1969.

This has already affected the electronics industry more than the mere percentage reduction in expenditure would indicate. The reason for this is that a large proportion of the total military budget remains fixed, while that alloted to electronic research and equipment forever remains subject to reduction or deferment.

As a result a considerable number of the more highly specialized companies dealing with missile and ordinance products are finding themselves landed with partly and sometimes fully developed facilities of little or no use to anyone outside the militia. To try to survive, therefore, many of these firms are seeking to merge or be incorporated by firms of good standing in the civilian markets. Recent surveys show the number of takeovers to be something like three to four every week. Other large companies, previously engaged in specialized fields, are endeavouring to find ways of entering the civilian markets by reorganizing their production, engineering and selling facilities.

However, there are still many fields which have not yet felt the influence of electronics and it is to these that the industry must now turn. Fields like medicine, industry, education, and even the consumer goods market will soon reap the benefits of electronic equipment and research.

We in New Zealand have not as yet felt the effects of these sweeping changes in the electronics industry overseas, but it does seem likely that in the near future we may expect to see many new developments in areas where we least expect them.

LOOKING AT
THE FUTURE IN TELECOMMUNICATIONS

Had this article been written 20 years ago, looking into the future as we now are, no possible account could have been made of the advent of transistors. Thus, it is not unlikely that in the near future some discovery will be made or new techniques evolved that will change electronic design philosophy as the transistor has done over the past 15 years.

However, fortunately for the writer, the world of telecommunications is a one of hard economic scrutiny. Improvements in solid (cable) communications and satellite communications are likely to engage the attention of communication engineers for some time yet.

It is the economic aspects of public demand that are likely to determine the immediate future of telecommunications rather than any major technological advances or even increased uses of present knowledge or materials. Balanced against this, however, is the fact that an improvement in quality and reliability of communications by any means increases the user demand and this was dramatically proved by the introduction of the first transatlantic telephone cable a few years ago—the increase in traffic demand resulted in the British CANTAT cable being laid as the first part of the Commonwealth cable link.

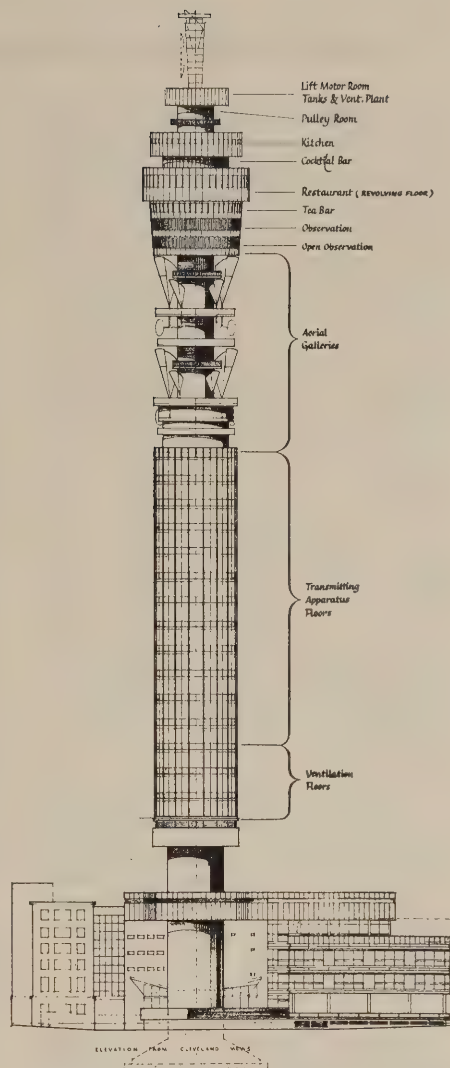
The field of telecommunications includes telegraph, telephone, high quality speech and music, television and data transmission and the demands and economics of these principal forms of communication cannot be separated when deciding upon a new telecommunication system — particularly when between populous continents such as Europe and North America.

The basic principles of voice telephony over lines has not greatly changed over the years, the main improvements being in equipment, and it is in this field that transistors are now playing an increasingly important part. The use of transistors results, generally, in smaller and cooler equipment rather than the introduction of new circuit ideas. Valve equipment has played an important part in telephony for 40 years or more but the use of valve equipment outside exchange buildings and repeater buildings has been restricted (or altogether avoided in most cases) on account of size and power supply problems.

The advent of transistorised amplifiers and like devices now means that special equipment can be installed in the subscriber's premises with little use of valuable space—in simple cases transistor amplifiers and selective networks can be fitted into telephone handsets or desk units.

One interesting possible development is the pressure sensitive transistor. In this device sound pressures from the voice diaphragm are transferred to the face of a semiconductor element the amplifying properties of which vary with the pressure applied. Such a unit would obviate the relatively high current required for the present carbon granule microphone. Allied with this reduction in operating current offered by this new development transistorised equipment generally means less current in subscribers' lines so that less copper can be used in subscribers' circuits making for cheaper overhead lines and cabling. This is a particularly important point in rural areas where line lengths can be many miles between subscribers and exchanges.

Another development, not necessarily requiring transistors, is a dial-less telephone in which push button selection of the wanted subscriber is used. This



reduces dialling time and, more importantly, is said to reduce dialling errors. The impulse dial on a standard telephone is one of the more frequent sources of trouble and deletion of the dial and replacement by a simple mechanism such as a set of push buttons should materially reduce maintenance calls to subscribers' telephones.

Still dealing with subscribers' equipment, the possible use of tones in place of a ringing bell has been investigated. From an exchange equipment point of view this would eventually do away with the ringing tone motor generator set used to generate the low frequency power and surely no subscriber would object to bells being replaced by something less strident.

Telephone Exchanges and Trunk Circuits

The advent of semiconductors and "computer type" circuitry led to the development of an electronic telephone exchange in

which electromechanical switching has been almost entirely deleted. A trial exchange was designed by the British Post Office and is now operating in Highgate, near London. Whilst the techniques are entirely revolutionary (from a telephone engineering viewpoint) and go a long way to solving the space and electromechanical maintenance problems found in a conventional exchange the distinct change presents new problems in compatability with existing Strowger type systems and in maintenance services. A new corps of maintenance staff will need to be recruited and trained in semiconductor technology. Conventional exchange equipment is extremely reliable and maintenance within the competence of relatively unskilled technicians. With electronic exchanges the question may well be "how far do we go with self indicating fault alarms." Too far makes the equipment over complicated and may increase equipment size and cost—the two factors that could eventually cause a swing to purely electronic exchanges.

Modern trunk or toll circuit trends were discussed in our issue of 28th February, 1962, but the recent development of a coaxial cable smaller than ⅜in. diameter—1/6in. diameter—may bring increasing use of coaxial circuits on medium distance links. Combined with transistorised repeaters and exchange equipment this new coaxial cable will allow for even smaller volume repeaters buried by the roadside. This does away with the need for above the ground repeater buildings at, say, six-mile intervals as at present. Whilst closer spaced repeaters will be needed (at three miles) a small, perhaps 18in. diameter, concrete pit should not be difficult to place along routes. Again, transistorisation reduces line currents.

The need for links to be capable of taking television transmissions is accepted but the wide bandwidth, 5 Mc/s, needed for some television transmissions is something of an economic problem for in this bandwidth 1600 telephone channels can be accommodated with high earning capacity. This is especially the case in any inter-continental submarine cable where at least 80% of occupancy can be achieved with telephone, telegraph and data transmission traffic. The feeding of a television programme over such a circuit would have to be certain of economic success. To be a success it would have to be "real-time" (live) and the time difference between London and New York, for instance, gives peak viewing times at different hours, so that one terminal or the other would have to record the programme to suit its own viewing hours and the real-time aspect as an economic justification immediately disappears. On cable circuits the 5 Mc/s bandwidth may be reduced to 3 Mc/s by deleting redundant information. Reports indicate that such reduced bandwidth transmissions are quite acceptable.

For land point-to-point television links and high density telephone traffic microwave links appear to be the immediate solution to bandwidth requirements and the new Post Office Tower in London (and in a lesser measure the proposed tower on the new Auckland telephone exchange) takes this into account. Initially the London Tower equipment will provide for 6000 Mc/s bandwidth on microwaves capable of 10,000 speech channels. Eventually 150,000 speech channels and 40 TV circuits will be provided.

Nevertheless, microwave circuits cannot be extended to the upper frequencies without attendant problems. For instance, above 10,000 Mc/s rainfall attenuation becomes troublesome and relatively short distance links are necessary.

Satellite Communications

The comments above have been restricted to "surface" links as global communications at present are either by solid (i.e. cable) means or H.F. radio. The immediate increase in traffic will be coped with by submarine and land cable links with microwave links interwoven as the crowded H.F. bands and ionospheric variations make further expansion of radio traffic difficult.

Satellite communication is undoubtedly the most profitable field of study for long term growth but is also the most costly involving two distinct operations and technologies—satellite launching and orbiting and communication facilities once in orbit. That satellite communication is seriously considered is evident by the recently announced allocation of spectrum to such systems. 6000 Mc/s of bandwidth was allocated late in 1963 for outer space communication—this being 15% of the R.F. spectrum against 1% as previously allocated.

Despite Telstar and similar satellites there is at present no communication satellite capable of giving 24 hour world-wide coverage and even Telstar is not geared to give limited commercial service of the standard expected by international users.

The main problem at present confronting planners is the number and orbital arrangements of satellites to provide continuous service. Basically, orbiting can be done at two levels, close to the earth at, say, 500 miles high or distant at some 22,000 miles. The latter is known as a synchronous orbit as the speed of the satellite is such that its rotation makes it appear stationary on the earth. Such a satellite then keeps a fixed position relative to the earth. To provide a 24-hour service three such satellites would be required. Figure 1 shows the various types of orbits.

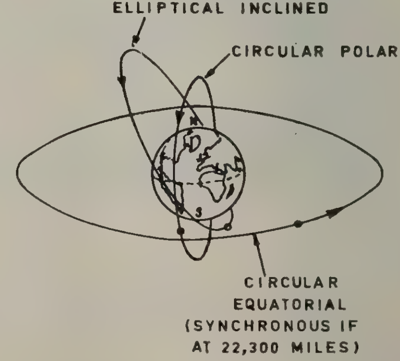


FIG.1 SATELLITE ORBITS.

Syncom Ib is an example of a synchronous orbit but is not stationary because the plane is inclined to the equator. Sub-synchronous satellites have a period corresponding to an exact fraction of 24 hours, say, 8 hours and their orbit is less than the 22,300 miles of a synchronous satellite—for 8-hour period the orbit would be at approximately 8600 miles. Heights from 3000 miles to 22,300 miles are favoured as these give the best period relationship with the 24 hour cycle.

The closer the orbit the less launching power is required but this is offset by the increasing number of satellites required to give complete coverage.

It is now generally agreed that the passive reflector type satellite is inferior in overall results to the active satellite containing receiver-transmitter equipment and current planning is based on active satellites. Table 1 (ref. 1) gives comparisons between the high and low orbit satellites.

Apart from launching problems the problems at present needing resolution before a continuous satellite system is put into orbit are those of operating frequency, modulation system and transmission time. The best frequency falls within the 1000-10,000 Mc/s band. The lower mark is set by galaxial noise and the upper by atmospheric absorption and rain noise. Figure 2 illustrates atmospheric attenuation as formulated by the Dumont Space Reconnaissance Laboratory. Due to the lower powers available from space satellite transmitters signals received at ground stations may only be in the order of 10^{-12} watts. These low received powers require receiving equipment of extreme sensitivity and low noise and the maser amplifier has promise in this direction.

The choice of low orbits will reduce the rocket power needed or on the other hand allow a greater payload for maximum rocket power so that more powerful transmitters can be carried to ensure reliable reception at earth relay points. Against this a greater number of satellites are required.

TABLE 1 (from Ref. 1)—

HIGH ORBIT SYNCHRONOUS SATELLITE

Advantages	Disadvantages
1. Few satellites required for coverage (except polar regions).	1. Poor reliability.
2. Only one non-tracking ground aerial at each station.	2. High R.F. power.
3. Minimum Doppler shift.	3. Attitude stabilisation equipment required.
	4. Difficult launch for correct station position.
	5. High launch thrust.
	6. Time delay in speech circuit to and back.
	7. Inability to cover polar regions.

LOW ORBIT SATELLITES

Advantages	Disadvantages
1. Comparative simplicity of satellite repeater design.	1. Large number required.
2. Destruction or failure of one satellite would not completely disrupt service.	2. Two tracking ground station aerials at each station.
	3. Accurate tracking.
	4. Satellite equipment problems due to radiation because of lower orbit.
	5. A.F.C. and lock on requirement in ground equipment.

TABLE 2 (from Ref. 1)—

SATELLITE-TO-GROUND POWER AND BANDWIDTH DETAILS

For 1200 Channel System, 50 dB S/N Ratio, 4 Kc/s Channel

Modulation System	Bandwidth Mc/s	Satellite 3000 mile orbit	Power 22,300 mile synchronous orbit
S.S.B.	5	20 W mean 115 peak	51 W mean 288 peak
Wideband F.M.	50	4	10
Pulse Code Modulation	37	2	5

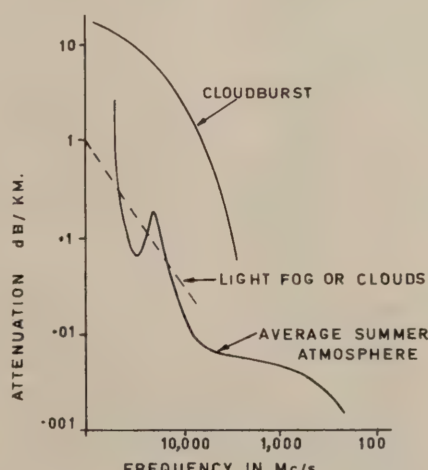


FIG. 2 ATTENUATION DUE TO VARIOUS ATMOSPHERIC FACTORS.

Three modulation methods are available: wideband frequency modulation, various methods of pulse code modulation and single sideband transmission. F.M. techniques are well known and proven but require broad spectrum bands. Certainly F.M. could provide reception of signals at the standard required by C.C.I.R.

Pulse code modulation provides a reliable signal of binary nature that can be determined with less error in conditions of high noise. The resultant signal is of a quality with broad band F.M.

Single sideband offers the advantage of bandwidth economy but the transmitter power requirements are high and for a synchronous (22,300 mile) orbit may require from 5 to 10 times as much power as other modulation methods. Nevertheless, the bandwidth economy of S.S.B. does not entirely rule out its use.

Table 2 compares the various modulation methods.

Several other problems affecting satellite communication have

not beeen touched on and some of these are station keeping, spin stabilisation and error correction. A major problem implied in any discussion of communication satellite systems is that of reliability and this aspect is allied to that of the chosen number of satellites. Random distribution of a large number of satellites at medium altitudes has been investigated. For a link between Scotland and Newfoundland it has been shown that 10 satellites randomly distributed would be needed for 90% service probability and 19 for 99% probability. For world wide service some 50 would be needed. In addition ground station repeaters are required for long links.

Random Systems

A hypothetical random satellite link with 6000 mile circular orbit for New York-London-Aden-Singapore-Sydney circuit would require the following number of satellites:

Probability of Service	No.
95%	36
99%	50
99.9%	68

Figure 3 shows in graphical form the probable service loss for such a random system.

The attractive feature of a random system, or any system, with a large number of satellites is that the failure of one or two does not mean a great loss in service time. Published opinion (ref. 2) is that 99% is a reasonable probability and from figure 3 49 satellites would provide this. Against this is the cost of such a number of satellites and the final chance of a small number, up to 12 (in synchronous or sub-synchronous orbit), of high reliability or a larger number perhaps of a power less in reliability has yet to be resolved.

Parallel Systems

The immediate future for global communications could hold development of satellite systems as back up for existing cable and H.F. links. This would allow full use to be made of the capital invested in existing systems whilst some of the traffic could be diverted to satellites to both relieve the pressure on systems and give the desired "traffic testing" of satellites in commercial circuits. By such means the present reliability of both methods would provide almost complete 100% service reliability.

There is no doubt that satellite systems can provide perfect circuits for intercontinental links but for a system to provide TV links between Europe and North America a cost of £40 million has been quoted with perhaps an annual ground cost of £10 million—unfortunately the make up of the ground cost has not been explained but the satellite cost alone indicates that the cost prohibits the use of such a link for TV alone. Telephone and public communication traffic is an economic necessity.

Because satellites offer wide-band width systems considerable communication information can be conveyed.

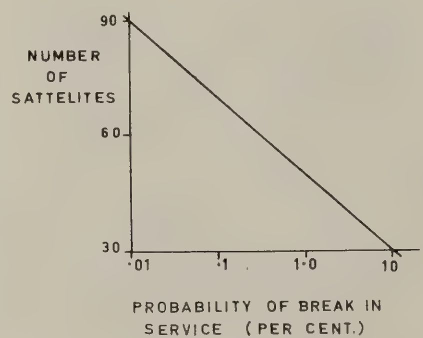


FIG.3 SERVICE DETAILS FOR 6500-MILE EQUATORIAL ORBIT.

Commercial Links

The number of channels so available and the modern development of pulse code modulation methods provide high reliability circuits for the transmission of commercial data in digital form. Apart from channel shortages the same facility is offered by submarine cable and microwave links. In Europe and the U.S.A. it is often the case that an executive will fly 2000 or 3000 miles to have as little as an hour's conversation with a business partner—just to obtain the required secrecy and to see "the glint in his eye." Here is a use for television and coded voice transmissions by digital means. In such systems the voice coding is done by means of "plug in" digital voice conversion sets that can be changed at each end of the circuit by arrangement. Given time any code or cypher can be broken but where urgent decisions are required that are effected immediately by the time the code is broken, say 8 or 10 hours later, the die is cast and the uncoded information valueless. In the case of commercial circuits opposing factions or business competitors would not have access to the channel in any case.

Visual Communication

At present the daily newspapers still have the lead in the presentation of a wide spread of news displayed in a permanent and referable form. Real-time television will offer instantaneous reporting via satellites of events in other continents and home television-video recording equipment could offer means of recording programmes for later presentation when real-time programmes are received at sleeping or working hours.

News presentation in either a permanent or selectable form could be received in the home by teleprinter or facsimile line transmission. The cost of the distribution of a newspaper is high and the acquisition of television networks overseas by newspaper organisations is a realisation of the possible decline of the daily paper as the medium of up-to-the-minute news. Political and economic power will probably remain with the permanent printed word for many generations yet but the pocket of the public—the growth of consumer demand—is a fickle thing requiring constant change of approach, even hourly, and it is here that telecommunications have the greatest social future and even frightening implications.

(Please see references on next page)

A Transistorised "Grid-Dip" Oscillator

By IRVING SPACKMAN ZL1MO

Strictly speaking, this instrument should not be called a "Grid-Dip" meter since transistors don't have grids — however, the term is used here as the letters G.D.O. have become universally known, and undoubtedly will continue to be used even if the equipment utilises transistors.

Recently whilst the author was carrying out some development work on a fully transistorised receiver and converter system, he found to his dismay that his conventional type of A.C. "power" operated G.D.O. using a standard vacuum tube circuit was the reason for the rapid and untimely demise of a couple of R.F. type transistors. This appeared to be caused by the fact that the voltage induced into tuned circuits associated with transistor amplifiers was sufficient to cause breakdown of the base-emitter junctions. Obviously then, a lower power G.D.O. was required and this indicated the requirement that the instrument should be transistorised, so that it could be self-contained, portable and free of the trailing mains power lead.

Several circuits were tried out with varying and sometimes indifferent results. The majority of these circuits utilised one transistor, usually operating in the grounded-base mode with a small capacitor coupling the "hot" side of the tuned circuit to a diode rectifier which in turn was connected to a second transistor operating as a D.C. amplifier to enable a 1 mA meter to be used as an indicator. This meter was included as part of a bridge network so that the meter reads close to zero when the oscillator is not functioning, rises when the oscillator is running, and dips in value when a resonant circuit is coupled to the G.D.O. coil.

The main difficulty with this system was the wide range of meter currents which prevailed, varying quite rapidly over the tuning range, thus necessitating continual operation of the control to increase or decrease the meter current when tuning over the range of a coil. Whilst this was not too bad in practise, it certainly was annoying to have to readjust the G.D.O. meter whilst attempting to make other adjustments at the same time. Also the ambient temperature affected the range somewhat due to the change of gain of the meter amplifier.

Recently the author was able to try out a circuit with a slightly different approach. This operated very well, and was not as temperamental as the previous circuits, and in addition did not require the use of either the diode or the D.C. amplifier. As can be seen in the circuit diagram, the meter is connected directly in series with the collector supply lead, shunted by the 5K ohm variable resistor which is a standard potentiometer. Facilities were included in each coil also to "plug in" a resistor which was selected to provide the correct amount of forward bias for the transistor. This system operates on the principle that when the transistor is not oscillating, there is only a small amount of collector current flowing. When oscillation occurs the increased base drive voltage causes a correspondingly amplified increase in collector current. If the feedback is reduced, for instance, due to coupling to another resonant circuit, then the base drive voltage is reduced, and the collector current drops also, in similar fashion to a normal G.D.O.

Frequency Coverage

Whilst the instrument has to date only been operated up to 100 megacycles, there is no reason why some of the newer transistors such as the AFZ12, AF102, 2NI742 or AF186 should not be utilised and in such event there is no reason why frequencies up to 200 megacycles or more should not be covered. Operation at such frequencies necessitates careful design and construction using the best V.H.F. techniques for short leads, low loss coil formers and socket, etc.

The tuning capacity suggested is a straight line frequency type. This allows a fairly uniform calibration to be used, and does not cramp the calibration at the high frequency end of each range. In the event of such a capacitor not being available, a straight line capacity condenser can be used, however, with the attendant cramping of the scale at the high frequency end.

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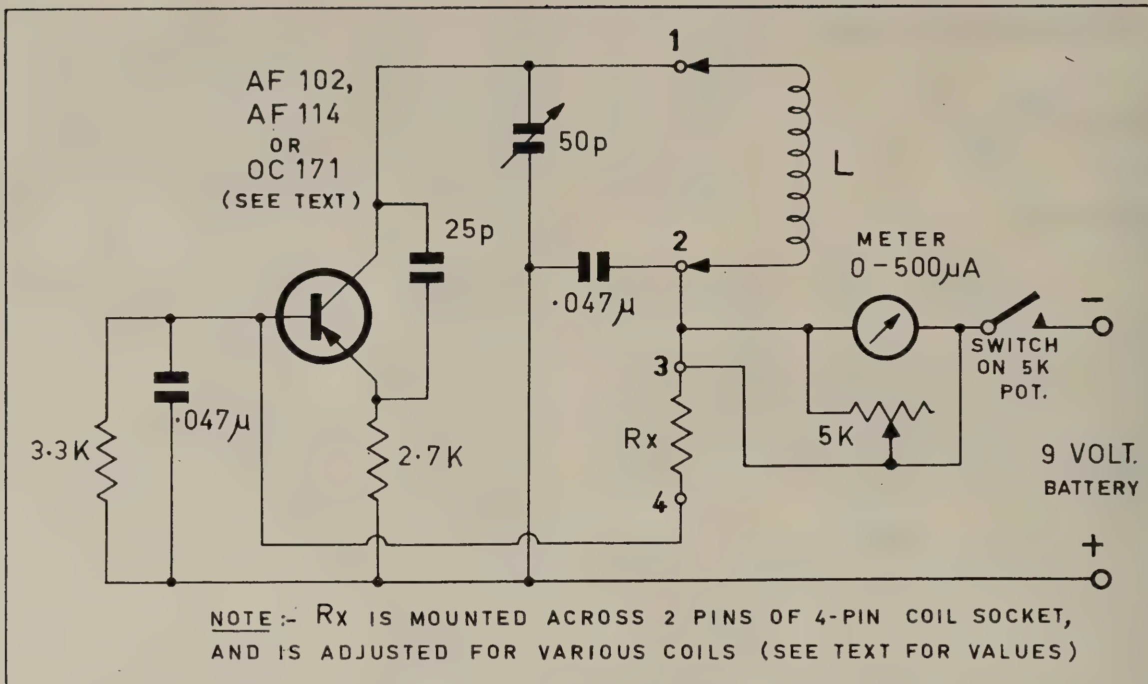


TRANSISTORISED GRID-DIP OSCILLATOR

The author used a set of coils similar to those constructed for his A.C. G.D.O. Small bakelite speaker plugs (Teletron or Amphenol types) were machined to fit inside lengths of ¾in. diameter perspex tubing which was then glued to the plug. In the low frequency coils, which were longer in length, the resistor was mounted first. In the high frequency coils, the resistor was easily mounted after the coil was wound and calibrated. It is suggested that the lowest frequency coil be wound first, then each succeeding coil can be adjusted to overlap the lower frequency one, by removing or adding a turn or two.

Coil Table

The resistor values are determined for transistor type OC171 and may have to be adjusted slightly for other transistor types.

Frequency Range	Turns	Resistor R.
1.3 - 2.5 megs.	140T No. 32E	33K
2.5 - 5 megs.	60T No. 28E	33K
5 - 10 megs.	20T No. 28E	15K
10 - 20 megs.	10T No. 20E	4.7K
20 - 40 megs.	5T No. 16E	6.8K
40 - 70 megs.	4T ½ diameter 16E	10K
	close wound and self supporting	

Calibration and Use

After all the coils have been adjusted and prior to final calibration, they should be heavily "doped" with perspex cement or a thin surface of epoxy resin adhesive. One very satisfactory method is to "pot" the coil in epoxy resin in a small aluminium or waxed paper tube. If an aluminium tube is used it should be greased inside prior to use to stop the material adhering to the inside wall.

The instrument can be calibrated over most of the lower frequency ranges by using a general coverage communications receiver. However, care should be taken to see that it is not accidentally calibrated on the image frequencies, instead of the true signal frequency.

A suitable dial can be prepared on white cardboard and this used as a template for an engraved type plastic panel. The knob can be fabricated from a circular disc of ⅛in. perspex of suitable diameter with a hair-line scratched on it and filled with black paint. This perspex disc can be glued or screwed to a suitable knob for mounting on the capacitor shaft.

Methods of Using the G.D.O.

It should be noted here that this G.D.O. is not a particularly successful absorbtion wave meter if the meter on the instrument is used. However, the use of any transistorised G.D.O. is **not** recommended as an absorbtion wavemeter with any circuit other than another transistorised circuit, otherwise the oscillator transistor could possibly be destroyed.

Many articles and texts have been published on the use of the G.D.O. Once a good instrument of this kind has been constructed it becomes indispensable. This unit has caused the author's older A.C. powered G.D.O. to be relegated to a back corner of a rather overcrowded work bench.

The author wishes to acknowledge with grateful thanks the information on the circuit used in this instrument which was by Mr. R. Dent of the Electronics section of the Chemistry Department, University of Auckland.

A TRANSISTORISED COMMUNICATION RECEIVER

For Mobile or Home Station Use

by Irving Spackman, ZL1MO

This receiver was developed as a standby receiver for home station use, and as such to be capable of top performance when used as a mobile or field day receiver. Thus, this receiver will also make an ideal companion for use with the V.H.F. mobile converters which were described in earlier issues of this magazine. It was designed to have better than average overload characteristics (an essential for field day operation), stable tunable oscillator (particularly for mobile use), a relatively selective I.F. amplifier, an amplified AVC system capable of use with CW, AM and SSB (particularly required for mobile service), a BFO and associated Product detector, and an audio system capable of at least 1-2 watts of audio power output. The receiver is easily constructed and aligned, whilst most of the circuits are uncritical and stable in performance characteristics. The whole receiver can be packaged into a relatively small volume, suitable for use in a vehicle.

The Circuit Description

The receiver can best be divided into four sections for the purposes of further description. These are:

1. R.F. stage; mixer, and Tunable Oscillator.
2. I.F. stages, and Noise limiter.
3. A.V.C. Detector and Amplifier, B.F.O. and Product Detector.
4. Audio Amplifier and D.C. regulator system.

In some cases it is difficult to confine the discussion purely to one section, where, in particular, there is some overlapping, e.g., the overload characteristic of the R.F. and I.F. amplifiers is determined in part by the type of A.V.C. used and the system used for deriving the controlling voltage.

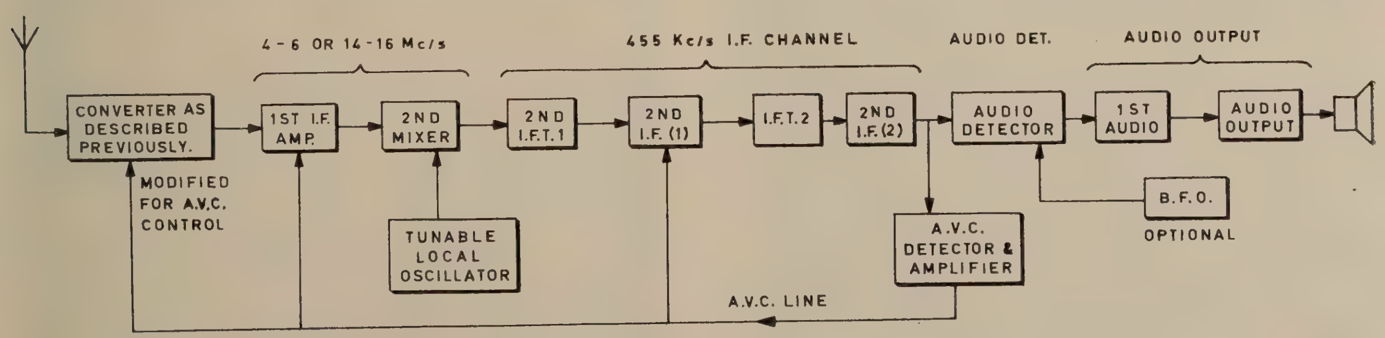
1. R.F. Stage, Mixer and Tunable Oscillator

In this receiver, as in all other communication receivers, the tunable circuits are really the heart of the equipment, particularly one which is designed with S.S.B. reception in mind. It is here that good components well constructed both electrically and mechanically are required. The problem is much simpler if the tuning range can be kept small compared with the frequency of operation.

It is very difficult to accommodate a tuning range of 500 kc. which is suitable for almost all of the amateur bands, and also 2 megacycles which is a requirement for usable coverage of the V.H.F. bands, above 50 megacycles, both in the one instrument, without a fancy system of coils, capacitors or both. Another point is that one is limited to the type of condenser gang for the tuning circuits as size, both in terms of capacity and physical dimension, and secondly and what is more important, availability, are both factors. The author used three of the 75 pf. gangable "Polar" capacities which were found in the R.F. tuning units No. 26 and 27. Many of these became available from war surplus overseas, and there must be many still lurking in junk boxes or on shelves in amateur shacks. With these capacities, calculations showed that a tuning range of 3.5 to 4 mc/s. or 4 to 6 mc/s. could easily be obtained by the use of parallel padding capacities without excess reduction of the dynamic impedance of the tuned circuit and thereby lower gain and Q. The parallel padding capacities can be calculated easily from the formula shown in the appendix, together with the worked examples.

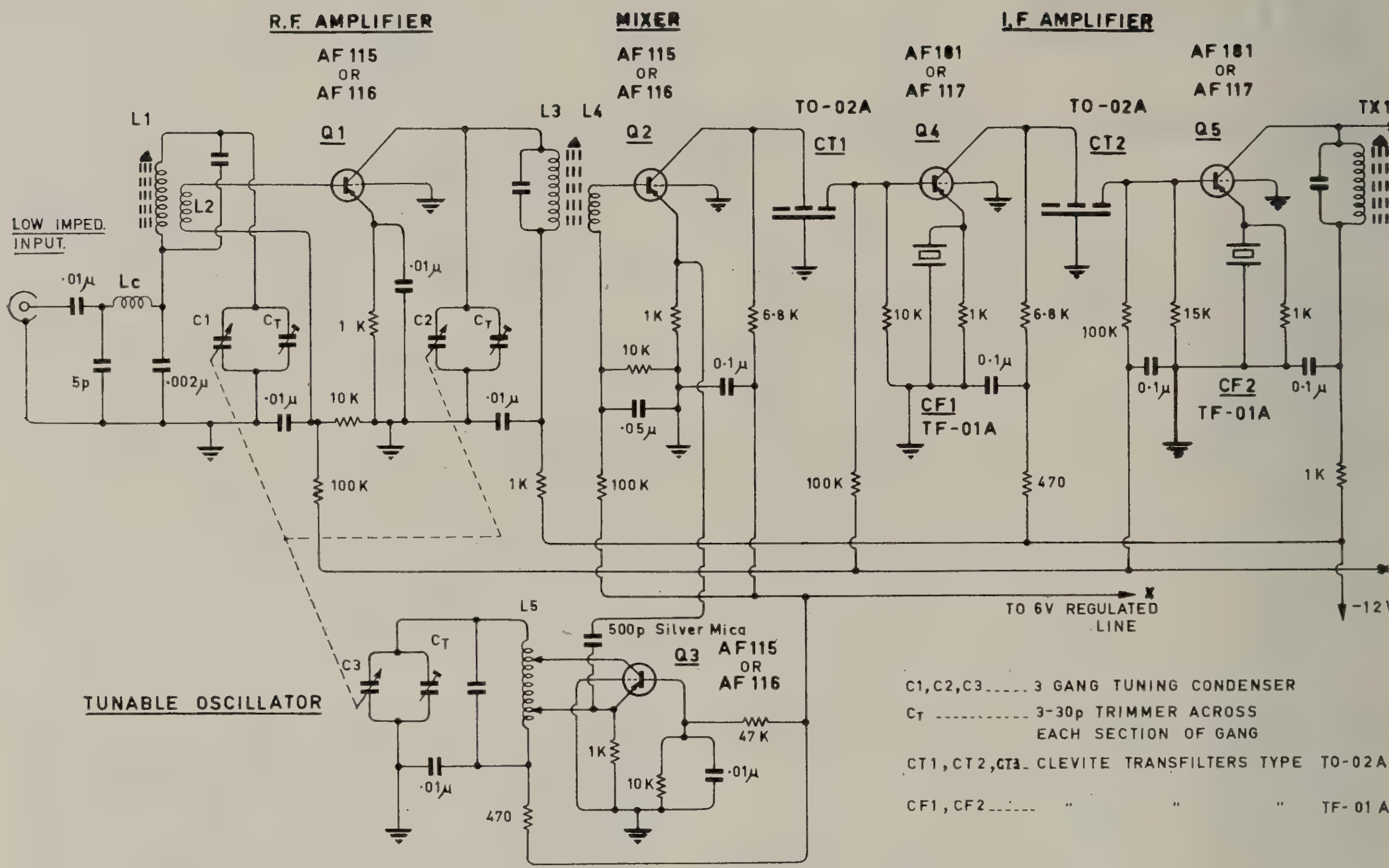
Transistor Types for R.F. Service

Among the types which are available at the present time are the Philips-Mullard series, AF115,



BLOCK DIAGRAM OF TRANSISTORISED RECEIVER FOR V.H.F. MOBILE.

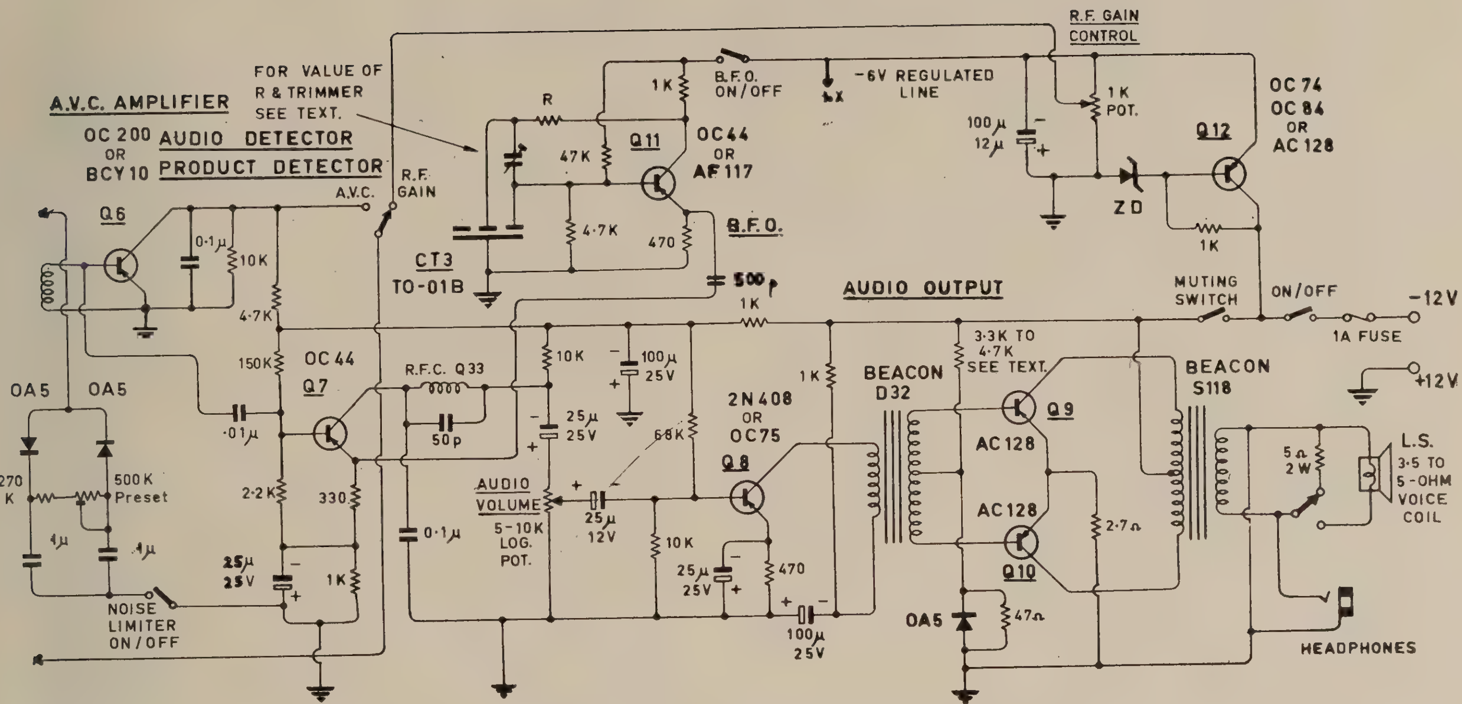
TRANSISTORISED MOBILE COMMUNICATIONS RECEIVER



AF125, AF116, AF126, AF117 and AF127. These are suitable for R.F., mixer and 455 Kc I.F. operation respectively. The two numbers ending with the same figure have basically the same characteristics, but differ in case design. In addition to these there are the AF179 and AF181 which are designed for large signal I.F. and forward controlled I.F. amplifier service in 35 megacycle TV I.F. amplifier service. As such, these transistors have somewhat better overload characteristics than the AF115-AF127 series. The author carried out a number of laboratory tests on a range of these transistors and found that the AF181 was ideal for the controlled I.F. amplifier transistors, operated under reverse rather than forward A.V.C. characteristics. When forward A.V.C. was used, at high forward bias voltages, there appeared to be a marked capacitive change in the transistors' collector characteristic which caused quite a marked shift in centre frequency of the transfilters. The AF115 and AF116 both appeared to be optimum for R.F. Mixer and oscillator service. The AF117 was not far behind the AF181 when used at 455 Kc in A.V.C. controlled I.F. stages, but exhibited a rather steeper gain versus A.V.C. control voltage curve.

Returning now to the circuit, the signal is fed to the R.F. transistor base via a noise filter in the antenna lead, and a tuned transformer. This transistor is operated in the grounded emitter mode with the collector connected directly across the tuned primary of the interstage circuit, which is identical to that used as the aerial coil. The mixer transistor has the signal applied to the base from the low impedance secondary of the R.F. transformer, and the local oscillator voltage is injected into the emitter circuit via a capacity from the emitter of the local oscillator. The supply voltage for the mixer, local oscillator, and B.F.O. is run from a regulated voltage source using a Zener diode and a small power transistor as a series regulator. This stabilisation is absolutely essential. Some readers may wonder why the mixer is stabilised, but this is done to avoid any pulling effect the mixer may have on the oscillator when the supply voltage varies. This could no doubt be overcome if an emitter follower was used between the oscillator and mixer, but the system used here performs very well and saves a transistor.

The local oscillator is a circuit which was used by the author in a V.F.O. some two years or more ago and it has proved exceptionally stable and reliable. In the original V.F.O. a large coil spaced



wound on a ceramic former was used. In the case of this receiver, a much smaller coil was required and was constructed using a ½in. diameter ceramic former with grooves moulded into it. The wire was wound on after it was heated to as high a temperature as could possibly be handled comfortably. When the wire cooled it contracted and made a very tight coil. No slug was used, but several trial coils were prepared prior to winding the final one in order that the inductance could be correctly set. (See further details in appendix.)

The oscillator transistor operates in grounded base mode with the collector tapped about half-way up the coil and the emitter connected via a capacity to a tap three turns from the earthy end.

The I.F. Amplifier System

This part of the receiver is very simple. No major alignment is required thanks to the use of Clevite Ceramic Transfilters as the interstage coupling elements. Transfilters are also used instead of emitter by-pass capacitors and these give considerable improvement in selectivity. The anode loads to feed the mixer and first I.F. amplifier are 6.8K resistors. With a 12 volt supply these permit about 6 volts to be available across the I.F. transistor with 1 mA. collector current. Under these conditions the full dynamic range of the first I.F. amplifier is still available for A.V.C. control. The second I.F. stage has virtually the full supply voltage available for the collector as an I.F. transformer is used as the collector load. The collector is connected across the full winding as the collector impedance of these transistors is in the vicinity of 1 megohm, at 455 Kc. A.V.C. is applied to both stages and, together with the R.F. stage, this enables the receiver to handle a wide range of signal strengths.

As the Transfilters are used throughout the I.F. amplifier, the only tuned circuit which requires adjustment is the I.F. transformer located between the second I.F. amplifier and the detectors.

The A.V.C. Detector-Amplifier, BFO, Product Detector

The last I.F. stage couples to the A.V.C. system and Detector through a standard I.F. transformer. The A.V.C. detector amplifier uses a silicon transistor and operates as a class B type detector and D.C. amplifier. This simple system provides A.V.C. delay due to the R.F. voltage required to overcome the intrinsic Vbe of the Silicon transistor. The collector is connected to the −12v. line via a voltage divider resistor network which sets the maximum

no-signal voltage which appears on the A.V.C. line to about –7 volts. For optimum performance in the R.F. and I.F. chain this voltage should not be any higher than –8 volts and this should not be exceeded even in a vehicle with high battery voltage. The use of a silicon transistor means that this voltage is relatively temperature stable, a condition which did not prevail using a germanium transistor in earlier experiments. The A.V.C. is fed, via the A.V.C.-R.F. gain, switch, to the A.V.C. controlled stages. The no signal idling current of these stages is set so that with increasing signal first the R.F. stage, then the first I.F. and lastly the second I.F. have their gain reduced to a minimum. However, the onset of the A.V.C. is delayed so that it does not degrade the weak signal performance of the receiver.

This A.V.C. system is basically a high impedance system. It will function when the B.F.O. is operating but is not readily adaptable to a "hang" A.V.C. circuit. The time constants for this system are short enough to cope with flutter in mobile equipment very well, but do allow a little background to appear between breaks in C.W. and pauses in S.S.B. signals. The author is currently working on a "low impedance" A.V.C. system which shows considerable promise and appears to be capable of providing various "attack" and "decay" time constants. This may well be the subject of a future note.

The Noise limiter is a shunt type and is connected across the last I.F. amplifier transformer. The time constant control can be preset or dispensed with altogether if desired. This unit was used in preference to a series-diode type noise limiter as there was no normal diode detector to provide the necessary automatic biassing arrangements for the series-diode type of limiter. The limiter shown in the circuit is commonly used in transistor and valve receivers, and works on all modes of reception and is very good for ignition noise. If the noise limiter is located some distance from the panel and its associated on-off switch, then shielded cable should be used for the lead. Alternatively, the switch can be neglected and the limiter wired permanently in the "on" condition as the author did. There are rarely any occasions when the limiter is switched off.

The detector also operates on all modes, and is capacity coupled to the secondary of the same I.F. transformer, which feeds the A.V.C. detector. The detector operates as a product detector on S.S.B. and C.W. (with the B.F.O. on) and as a class B or power detector for A.M. In addition, it functions as an audio amplifier, thus reducing the remaining number of audio amplifier stages. This circuit was first used by T. L. Thomas in "The T.D.C.S. Communication Receiver" described in November, 1963, QST. A 2.5 mh. R.F. choke in parellel with 50 pf. is used in the collector circuit as a filter together with a sizeable by-pass capacity to remove any 455kc I.F. energy from the audio before it passes into the audio amplifier system.

The B.F.O. is similar to that described by the author in a previous article and uses a Transfilter as the tuned circuit. A 50 pf. trimmer capacitor connected across the filter as shown in the circuit enables it to be tuned through the I.F. frequency range. If a variable capacitor is required, the variable must be one with both the stator and rotor insulated from earth. Less variation can be obtained by placing the capacitance from the collector side of the filter to ground. If it is inconvenient to use a tuning capacitor, but a variable B.F.O. is required, then consideration should be given to the use of a variable capacitance diode such as the BA102. Two of these, in parallel, could be operated from the front panel via a potentiometer connected across the regulated supply line. This B.F.O. is very stable, with performance midway between that of a conventional tuned circuit, and of a quartz crystal, and forms the final link in the high stability chain necessary for satisfactory S.S.B. reception.

The output from the B.F.O. is coupled out from a low impedance source, this being the emitter circuit of the oscillator transistor, to the emitter circuit of the product detector transistor. As the detector provides considerable isolation from the B.F.O. back to the I.F. chain, little B.F.O. voltage finds its way to the A.V.C. detector. Consequently A.V.C. can be used even when the B.F.O. is operating, providing there is adequate isolation and shielding between these two sections. This means plenty of by-passing and de-coupling is necessary.

The Audio Stages and Regulator Section

Having a reasonable audio voltage available from the detector means that the audio amplifier is relatively simple. The first audio transistor is preceeded by the audio volume control and operates as a driver stage for a pair of AC128's operating in Class B. These are capable of giving nearly two watts output into a speaker, which is adequate even for the average mobile. If less power is needed then a pair of OC84's will give a little over 1 watt whilst a pair of OC72's or 2N217S's will deliver close to 1 watt. The OC84's will operate satisfactorily with the existing transformers but other types of transformers may be required for other types of transistors. These can be readily found by consulting the manufacturers' catalogues.

The output transformer is switched either to a speaker or to a dummy load and a jack socket is provided for a pair of headphones.

The series regulator is used to provide a source of approximately 6-9 volts for the tunable and beat oscillators, the mixer and the R.F. gain control. The total current drawn by these stages exceeded that which could be satisfactorily controlled by a low power Zener diode. The regulator also helps provide a large measure of improved filtering for the sections it serves when the receiver is being used from dry batteries, in the open, and the audio amplifier is delivering considerable power to a speaker. If the regulation of the power source is poor, then the

(Please turn to page 29)

Circuit and Service Autocrat TV Receiver "Vega Altair"

ADJUSTMENTS:

A service test receptacle, accessible from the rear of the cabinet after the back has been removed, provides the following test points (underneath view):

Pin	Connection to:
1.	B + 2
2.	Tuner AGC
3.	I.F. AGC
5.	AFC Ref.
6.	A.F.C. output
7.	Earth

PICTURE WIDTH:

This control is factory adjusted and normally should not require any adjustment in the field. Readjustments can be made as follows:

1. Mains to 230 volts.
2. VTVM to 1500 volts scale.
3. Remove EHT cage cover.
4. Probe to Boost rail.
5. Adjust potentiometer adjacent to line output transformer (or on later models above horizontal linearity coil on the linearity panel).

HORIZONTAL LINEARITY:

To adjust, release hex. locking nut and adjust metal insert.

1. Contrast control set to minimum.
2. AGC control adjusted till a milky picture without sync. is obtained.
3. Check operation of contrast control for normal picture black level.

HORIZONTAL OSCILLATOR ADJUSTMENT:

1. Bypass pin 5 of rear test socket to ground with a .47 uf capacitor.
2. Set phase pot approx. 2/3in. rotation in clockwise direction (when viewed from rear of chassis).
3. Adjust horizontal hold slug until floating picture appears.
4. Remove capacitor from pin 5.
5. Adjust horizontal hold if any horizontal fold is visible on raster.

I.F. ALIGNMENT PROCEDURE

Remove Yoke Plug from socket.

Attach 2,000 ohm 20 Watt resistor between B + 1 and chassis.

B + 3 to I.F. Board should be + 21OV. and filament voltage 6.3V A.C.

Supply — 8V. bias to I.F. (Test socket pin 3).

Connect oscilloscope to test point "B" on I.F.

Board — set for 2V. P.P. reading.

Connect sweep generator to test point "A" on I.F.

Board via 1,000 pF capacitor.

Set sweep generator output to give 2V. P.P. output on oscilloscope screen; adjust the I.F. transformers for peak output at the points on the response curve at which the markers occur:

L107 Video detector 36.9 Mc/sec. peak nearest to P.C. Board.

L106 2nd I.F. 34.9 Mc/sec. peak nearest to P.C. Board.

L105 1st I.F. 38.9 Mc/sec. peak nearest to P.C. Board.

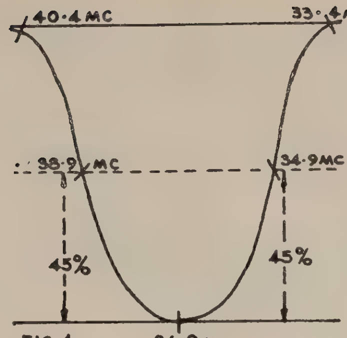


FIG. 1

Repeat sequence to obtain a curve similar to figure 1.

TUNER — I.F. BOARD LINK — CIRCUIT ALIGNMENT

Change sweep generator connection from point "A" to test point on tuner.

Switch tuner to blank channel.

Reduce bias if required during alignment of traps.

L101 Top coil 31.9 Mc/sec. marker for minimum.

L102 Bottom coil 40.4 Mc/sec. marker for minimum.

NOTE — These two cores interreact and for the proper tuning must be positioned on the outside of the coils.

Repeat if necessary to obtain minimum gain at 40.4 Mc/sec. without a kink in the slope of curve towards the 38.9 Mc/sec. marker.

L103 Top coil 33.4 Mc/sec. marker for minimum.

NOTE — Core position on outside of coil.

Readjust bias to – 8V. and adjust output of sweep generator for 2V P.P. on oscilloscope screen.

Adjust L104 secondary converter coil in conjunction with core of primary I.F. coil on tuner to obtain a response curve similar to figure 2.

NOTE — The core tuning L104 secondary converter coil must be tuned to the outside peak. It may be necessary to repeat sequence from L101 to obtain correct curve.

NOTE — This curve should maintain a substantially constant shape with a bias change from 0 - 12V.

SOUND ALIGNMENT (Station Signal Method):

NOTE: The sound I.F. Alignment is based upon a properly aligned video I.F. strip.

DESCRIPTION: The sound system consists of 5.5 Mc. I.F. amplifier/limiter stage V7 pentode, a quadrature grid detector V8 and output stage V10 pentode.

**Since this type of sound system is extremely sensitive, relatively small input signal voltage will cause grid current to flow in both I.F. amplifier and detector stage. This grid current will load the tuned coils, making them broad and alignment impossible.

Very weak signals, on the other hand, will not lock the quadrature oscillator, also causing a condition in which alignment is impossible. For this reason it is necessary to use a signal which can be gradually attenuated.

(See chart page 22)

PRELIMINARY STEPS:

1. Tune in a strong TV station.
2. Adjust all controls for normal picture and sound.

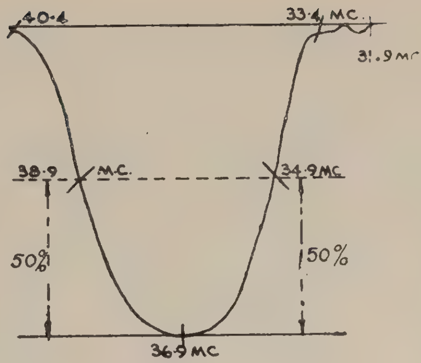


FIG 2.

SOUND ALIGNMENT (Signal Method):

Test signal required 5.5 Mc/sec. F.M. modulated sine wave 15 K/c. deviation with 230 A.C. mains input, yoke plug removed and B+1 loaded with 2,000 ohm 20 watt resistor and test signal connected to video test point "B" on I.F. Board and chassis.

Apply — 15 volts or more to I.F. A.G.C. line.

Tune to blank channel. If this is insufficient to keep noise out, remove 6EH7.

Contrast potentiometer minimum. Volume potentiometer minimum.

C.R.O. vert. amp. lead to detector output (S1-1) and adjust vert. amp. gain to accept 50V. P.P. Adjust sync for steady sine wave. With strong test signal into test point "B" apply V.T.V.M. to junction of R213, C212 and bottom of L202.

Tune L202 and secondary of L201 (bottom core) for maximum neg. voltage (–2 to – 3.5V. approx.) Attenuate signal to the point where break out just occurs. This will be seen on CRO as serrated top or bottom of sine wave. Tune L201 secondary (bottom core) to remove break out and reduce signal input. Retune and repeat until lowest input at which lock occurs is reached. Then tune L201 primary (top core) in like manner.

NOTE: Both primary and secondary core must tune to outer peak. Tune L111 (bottom core) and L110 (top core) to point where lock can be produced with minimum signal input.

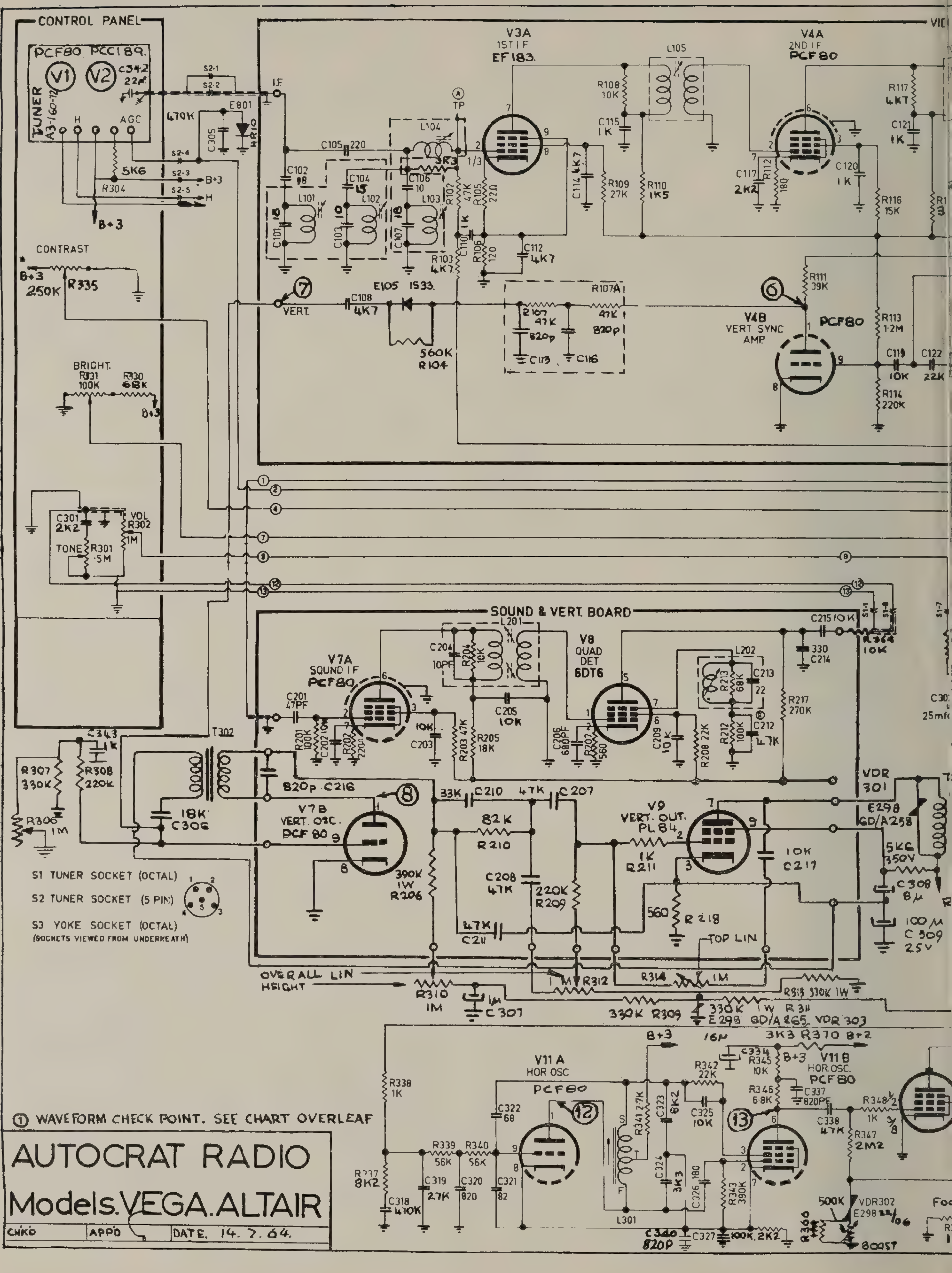
NOTE: Both primary and secondary core must be tuned to outer peaks. Repeat tuning operation from L201 to L110.

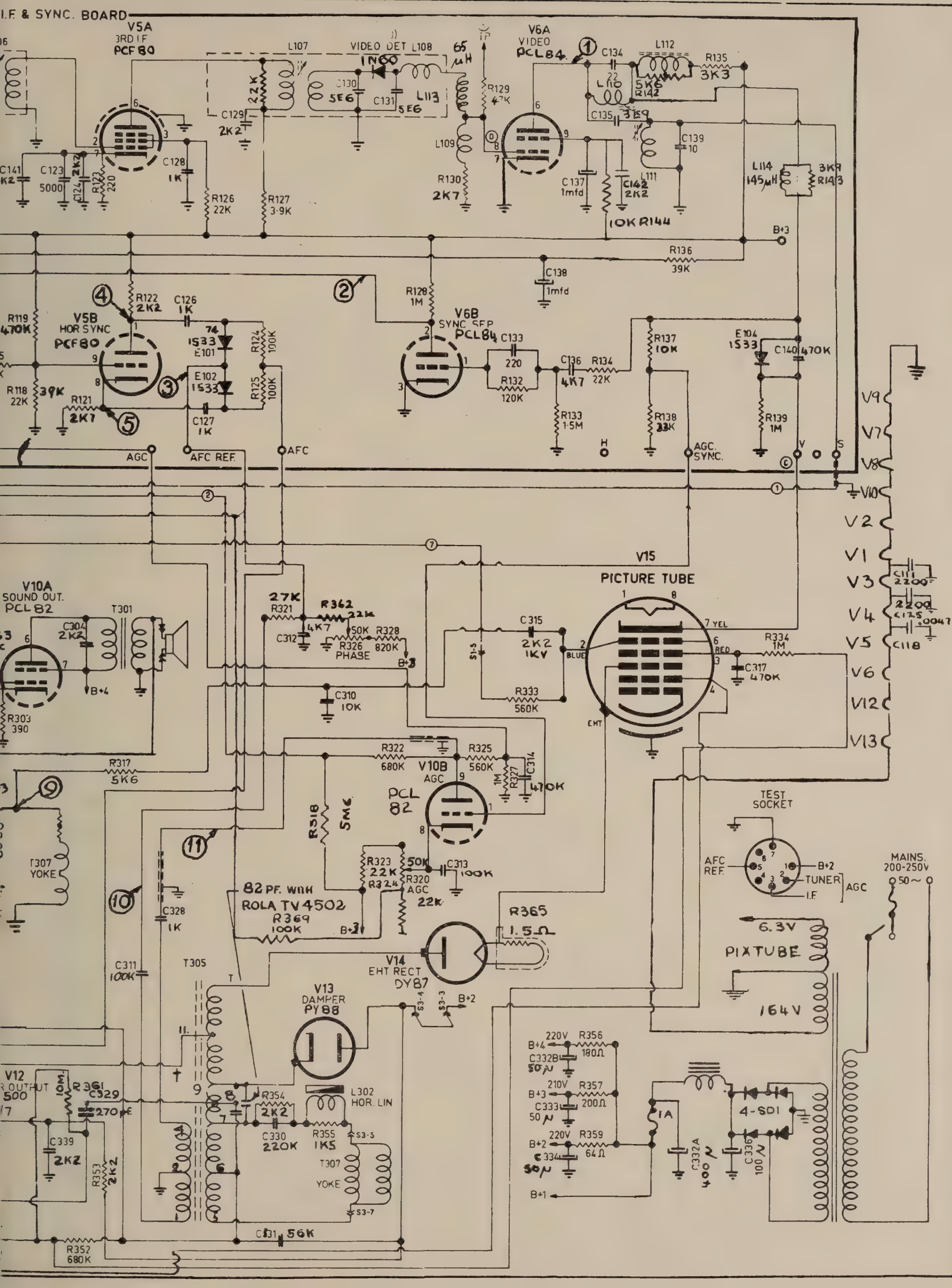
Retouch L202 to check lock at minimum signal input as L202 is tuned high or low; sine wave should break out at top and bottom at approx. same degree of core variation. Proper position of L202 core gives maximum sine wave output, and at this position the bias developed is slightly less than the maximum previously obtained.

Amplitude of sine wave should not vary more than 30% from minimum signal required for lock to full signal.

Turn up volume control with minimum signal applied; a clear sine wave without any rattle noise should be heard.

(Turn to page 22)


CONTROL PANEL
TUNER A3-160-17
PCF80 PCC189
V1 V2
AGC
CONTRAST
R335 250K
BRIGHT.
VOL
TONE
V3A 1ST I F EF183
V4A 2ND I F PCF80
V4B VERT SYNC AMP PCF80
SOUND & VERT. BOARD
V7A SOUND I F PCF80
V8 QUAD DET 6DT6
V7B VERT. OSC. PCF 80
V9 VERT. OUT. PL84
V11 A HOR OSC PCF80
V11 B HOR.OSC. PCF80
OVERALL LIN
HEIGHT
TOP LIN
BOOST
S1 TUNER SOCKET (OCTAL)
S2 TUNER SOCKET (5 PIN)
S3 YOKE SOCKET (OCTAL)
(SOCKETS VIEWED FROM UNDERNEATH)
① WAVEFORM CHECK POINT. SEE CHART OVERLEAF
AUTOCRAT RADIO
Models.VEGA.ALTAIR
CHK'D
APP'D
DATE. 14. 7. 64.


I.F & SYNC. BOARD
V5A
3RD I.F
PCF80
L107
VIDEO DET
1N60
L108
65 μH
V6A
VIDEO
PCL84
C134
L112
R135
3K3
C129
2K2
C130
5E6
C131
5E6
L113
R129
4.7K
L110
5K6
R142
C135
3E9
C139
10
L109
R130
2K7
C137
1mfd
C142
2K2
L111
L114
145μH
3K9
R143
C141
C123
5000
C124
R123
220
C128
1K
R126
22K
R127
3·9K
10K R144
B+3
R136
39K
C138
1mfd
R128
1M
V6B
SYNC SEP
PCL84
C133
220
R132
120K
C136
4K7
R134
22K
R137
10K
R138
33K
R133
1·5M
E104
1S33
C140
470K
R139
1M
R119
470K
V5B
HOR SYNC
PCF80
R122
2K2
C126
1K
1S33
E101
E102
1S33
R124
100K
R125
100K
R118
22K
39K
R121
2K7
C127
1K
AGC
AFC REF.
AFC
H
AGC. SYNC.
V
S
V9
V7
V8
V10
V2
V1
V3
V4
V5
V6
V12
V13
C111
2200
2200
C125
.0047
C118
V15
PICTURE TUBE
V10A
SOUND OUT.
PCL82
T301
C304
2K2
B+4
R303
390
27K
R321
R362
22K
4K7
C312
50K
R328
820K
R326
PHASE
B+3
C315
2K2
1KV
BLUE
7 YEL
RED
R334
1M
C317
470K
R333
560K
C310
10K
EHT
R317
5K6
R322
680K
V10B
AGC
R325
560K
R327
1M
C314
470K
PCL 82
R318
5M6
T307
YOKE
R323
22K
R324
50K
R320
AGC
22K
C313
100K
TEST SOCKET
AFC REF.
B+2
TUNER
I.F
AGC
MAINS.
200-250V
50 ~
82 PF. WITH
ROLA TV4502
R369
100K
B+3
R365
1.5 Ω
V14
EHT RECT
DY87
6.3V
PIXTUBE
164V
C328
1K
C311
100K
T305
V13
DAMPER
PY88
S3-4
S3-3
B+2
V12
R OUTPUT
R361
10M
C329
270 PF
C339
2K2
R354
2K2
L302
HOR. LIN
C330
220K
R355
1K5
S3-5
T307
YOKE
S3-7
R353
2K2
C331
56K
R352
680K
220V
R356
180 Ω
B+4
C332B
50 μ
210V
R357
200 Ω
B+3
C333
50 μ
220V
R359
64 Ω
B+2
C334
50 μ
1A
C332A
400 μ
C336
100 μ
4-SD1
B+1

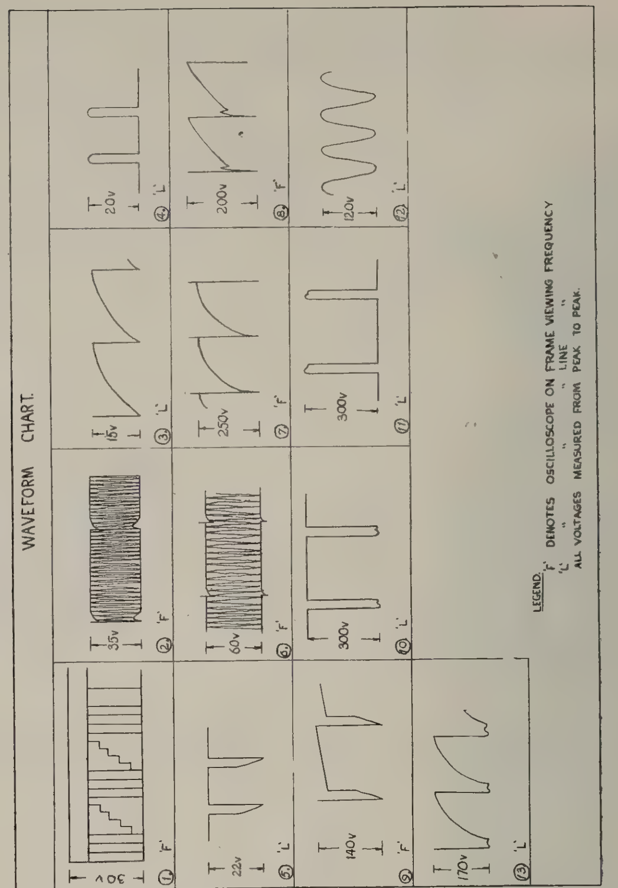
All voltages D.C. with VTVM taken to earth

VALVE	TYPE	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9	
1	ECC189										Tuner
2	ECF86										Tuner
3	EF183	0.4 *2.1	-12 *-1.5	0.4 * 2.1	0 0	6.3V A/C	0 0	205 *195	185 *135	0.36 *1.06	1st. I/F
4	ECF80	21 *21.5	0 0	175 *170	6.3V A/C	0 0	180 *175	1.9 *1.8	0 0	-3.15 *-2.35	2nd. I/F Vert.Sync
5	ECF80	190 *185	0 0	15.5 *150	6.3V A/C	0 0	185 *190	2.15 *2.1	23 *22.5	15 *15	3rd. I/F Hor. Sync
6	ECL84	-36 -19	74 94	0 0	6.3V A/C	0 0	120 108	0.34 0.3	-1.15 -0.7	170 100	Video Amp. Sync.Sep.
7	ECF80	150 *155	-3.4 *-0.2	150 *130	0 0	6.3V A/C	145 125	1.3 1.7	0 0	-57 -56	Limiter Vert. Osc
8	6DT6	0 0	4.55 3.3	0 0	6.3V A/C	140 146	82 102	0.04 -0.06	-	-	Quad. Det
9	EL86	-		21.5	0	6.3V	N/C	220	N/C	220	Vert. Op.
10	ECL82	60	18	0	6.3	0	200	220	84	-20	Audio Op. AGC.
11	ECF80	195	-60	165	6.3	0	155	22	22	7.8	Horiz.Osc
12	EL500	-56	-56	0	0	6.3	190	190	N/C	N/C	Horiz Op.
13	EY88	N/C	230	N/C	0	6.3	N/C	N/C	230	230	Damper
14	DY87	0			17.5Kv						EHT Rect.
15	Pix Tube	0	**120	420	0	0	0	***160	63V	-	CRT

The voltage on Pin 1 ECL82 (AGC) will vary between 50V-70V according to the position of Contrast Control i.e.
50V Max. Contrast
70V Min. Contrast

** CRT Voltages Pin 2 range 25 to 130

*** CRT Voltages Pin 7 range 125 to 140



OPERATING VOLTAGES

(Measurement Conditions)

Brightness and Contrast set for normal picture, volume minimum, 10mV signal input.

* Zero signal input (Shorted aerial input)

Channel 1 all controls adjusted for correct normal picture
Mains input 225V, 50 c/s
Fil. 6.3V AC Mains transf. Sec. 190 AC
B+on bridge rectifier 240V.

B+1, 229V, B+2, 220V, B+3, 214V, B+4, 210V.
Ripple B+1. .2Vpp (taken with VTVM).
Boost 850 V EHT 16.5 KV (Min. Brightness 17.5 Kv).
Total H.T. Current:—

No signal 345mA.
signal 325mA.

STEP	STATION	INDIC.	ADJUST	REMARKS
1	Strong signal	VTVM to jct. R213 and C212 Located near L202	L202 quad. coil.	Max. deflection neg. voltage (coarse adjustment). Of two possible max. use largest voltage reading.
2	Strong signal	Listening test	L202 quad. coil.	Max. sound min. distortion, approx. with a ¼ turn of slug from above position.
3	Attenuate signal to just into noise and break out can be heard. ** see under description.	Listening test	L201 bottom core.	Adjust for max. sound min. distortion. Keep attenuating and adjusting till no further improvement can be made.
4	Attenuate signal to just into noise and break out can be heard. ** see under description.	Listening test NOTE: CORE SHOULD BE ON OUTSIDE OF COIL.	L201 top core.	Adjust for max. sound min. distortion. Keep attenuating and adjusting till no further improvement can be made.
5	Attenuate signal to just into noise and break out can be heard. ** see under description.	Listening test NOTE: CORE SHOULD BE ON OUTSIDE OF COIL.	L111 bottom slug on IF board.	Adjust for max. sound min. distortion. Keep attenuating and adjusting till no further improvement can be made.
6	Attenuate signal to just into noise and break out can be heard. ** see under description.	Listening test NOTE: CORE SHOULD BE ON OUTSIDE OF COIL.	L110 top slug.	Adjust for max. sound min. distortion. Keep attenuating and adjusting till no further improvement can be made and observe minimum 5.5 mc. beat on pix.

MODIFICATIONS:

27th June, 1962.

1. V3A on schematic 6EH7/EF184—read EF183.
2. V14 on schematic 1S2—read DY87.
3. E302/303 on schematic — add 1N1763/1N3254 HR24.
4. C342 on schematic — add 22pf.
5. In models equipped with B79 power transformers — R358 10Ω deleted.
6. In all models after serial No. 15808 C330A .1 μf deleted.
7. In all models after serial No. 15808 R347ABC 3 x 680K — replace by R347 2.2M.
8. In all models after serial No. 15808 R351AB 2 x 4 470K — replace by R351 1M.
9. Replacement T.V.B. 110 by B90 Blocking OSC.
   R308 ½ Watt Carban: 3.3 Megohm now 2.2 Megohm.
   C108 Ceramic, 350 wv. .0047 MFD now .0033 M.F.D.

COLOUR CODING OF B90 LEADS

Black: R206, 1 watt, 3.3 Megohm.
Yellow: Pin 1 Frame Osc, ECF80.
Green: C108, .0033 MFD, Video Panel.
Blue: Pin 9 Frame Osc, ECF80.

SERVICEMAN'S COLUMN

Conducted by J. Whitley Stokes

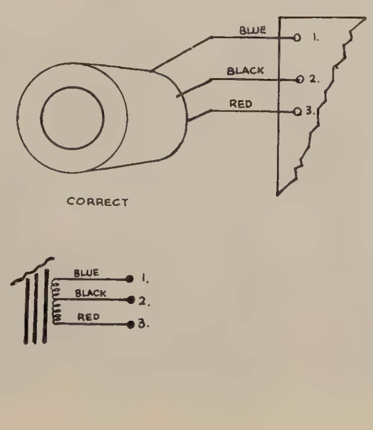
The other day I had a classical case of frozen diagnosis—in the true Jack Darr tradition—yes it happened to me, too, in spite of all precautions, and this is how it came about. I had a TV chassis in for repair which was about two years old and which, according to the owner, had given uninterrupted service up till now when during the previous evening's viewing it had stopped suddenly, no sound, no picture, no raster. From this description I mentally diagnosed a faulty line output transformer. As it turned out I was right too, but as I was to discover there was more to it than that.

Before condemning the L.O.T. I made the usual checks and tried new valves but everything pointed to the L.O.T. Nevertheless, I still had the feeling something else was wrong and so it was, for when I checked the drive to the EL36 output valve it showed about 100v. **positive** on the grid. Faulty coupling condenser from the line oscillator? No. What then? Recourse to the manufacturer's schematic showed that the only other component which could cause this state of affairs was in the E.H.T. regulation circuit which in this case consisted of a feedback network from a tap on the L.O.T. to the grid return of the EL36. There was a 470pF condenser coupled to the low end of the grid resistor and a check showed it to be shorted. At the same time a burning smell was noticed accompanied by a small wisp of smoke from the 1 meg pre-set E.H.T. and width control. This control was connected through a V.D.R. to the grid return at the same point as the shorted condenser. However replacement of this control plus a new condenser, although removing the positive grid voltage, still didn't bring the set into operation so this time I went ahead and wired in a new transformer.

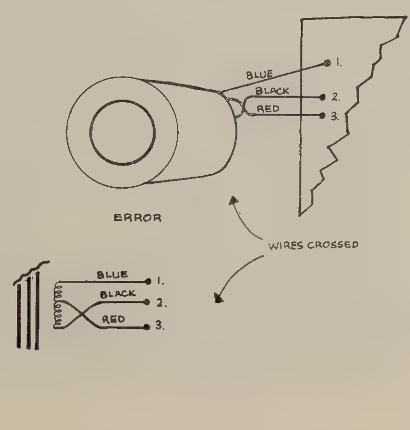
Now we were getting somewhere—boost 850v, EHT 16KV, raster normal. I hooked the aerial on and turned up the volume—no sound. At this stage I started to wonder just how many more things I was going to find wrong. A check disclosed no voltage on the plate of the 6DT6 quadrature detector. As this valve derives plate voltage from B+ boost the thought occurred that, during the time when things went wild, the decoupling condenser in the 6DT6 plate circuit had popped. It had, but I noticed that although original it was of only 500v DC wkg. when according to specifications it should have been 1KV. After replacement the sound or at least some sort of noise was emanating from the speaker so I turned my attention to the picture side but the only "picture" to be seen was a few black and white patches which looked very much like the results of extreme overloading in the video I.F. section. A check of the AGC showed no voltage present on either tuner or I.F. As I'd been using the VTVM to check the AGC voltages I thought I'd check to see if the AGC keyer valve was getting any pulse from the L.O.T. I switched the VoltOmyst to A.C. 1400v. range and stuck the prod on the plate terminal and measured around 300v. P.P. which was quite sufficient to operate the keyer valve I thought.

It was at this point that the frozen diagnosis set in. The trouble just had to be in the AGC circuit—I went over it with a fine tooth comb, changed valves, checked the wiring for shorts, checked condensers, checked resistors. Everything was O.K. except no AGC voltage. That old standby of the AGC troubleshooter the bias box was hooked up and picture and sound were normal. I'd reached the stage where the only thing to do was to give it a rest, and wait for the brain to become thawed out! Later on (considerably) I came back to it trying hard to forget my earlier diagnosis. I'd start at the beginning but this time I used the 'scope in place of the VTVM and this time I struck oil because when I checked the waveform of the AGC pulse at the keyer plate it showed **negative**-going instead of positive! No wonder there was no AGC voltage being developed, but the important thing was, what was causing the reversal of normally positive-going pulse? I checked over the wiring to the centre-tapped winding on the L.O.T. thinking it might be reversed but it was correct. Next step was to check the waveform on the other half of the winding which is used to supply a reference pulse to the phase discriminator. This is a negative-going pulse of the same magnitude but 180 degrees out of phase with the AGC pulse. It showed negative-going all right but over 50% higher than normal—there was only one answer, the new line output must be defective! Before ripping it out I took a close look at the lead-out wires from the winding to the terminal board, these leads are insulated with different coloured sleeving for purposes of identification (refer illustration).

Please turn to Page 31



CORRECT



ERROR

A New High Efficiency 50kW M. F. Broadcasting Transmitter

*by D. F. Bowers**

This article describes a 50 kW broadcast transmitter suitable for M.F. use.

Medium wave broadcasting has been given a fillip in "Western" countries by the popularisation of the transistor portable receiver, due mainly to its convenient size and the directional properties of the inbuilt ferrite aerial giving good reception in otherwise unfavourable areas.

In developing countries medium wave broadcasting is still the chosen method to reach the city-based population and much of the hinterland.

It can therefore be argued that medium-wave broadcasting will satisfy a need for many years to come and that the replacement of obsolete equipment can be considered on an economic basis and a new service likewise can be guaranteed a worthwhile life.

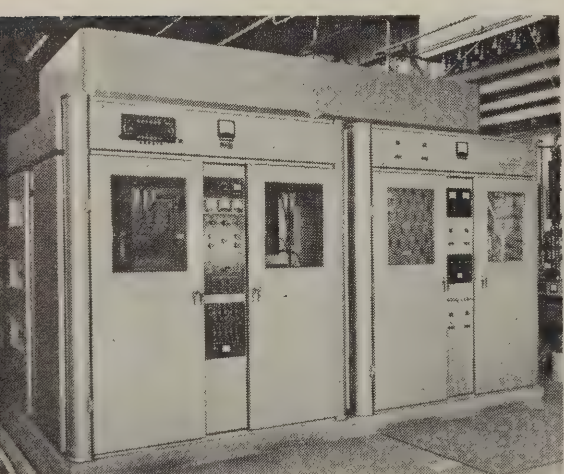
The 50 kW M.F. transmitter described comes from a company with a history of know-how yet it differs from earlier equipment in two significant ways.

The major difference is the embodiment of the high efficiency radio frequency amplifier technique[1] which is exploited by a single valve of recent design operating at relatively low h.t. voltage.

The second major difference concerns construction. The transmitter is housed in two cubicles which are fully erected in the factory and transported as units to site. On installation the cubicles are bolted together to form a single free-standing unit. The transmitter can be installed on a flat floor and requires no plinths or floor ducts. Low noise air cooling is employed with a relatively small flow of air, using a simple suction fan and ducting arrangement.

Fig. 1. Front view of transmitter on test in works (illustrated below).

Figs. 2 and 3 (not illustrated). Show the tubular steel framework of the transmitter.



Mechanical Construction

The transmitter proper is built into two cubicles which can be bolted together to form a single free-standing unit 13ft. 0in. wide by 6ft. 6in. deep by 7ft. 2in. high. The complete transmitter is shown in Fig. 1 with the radio frequency amplifiers in the cubicle on the right-hand side. The other cubicle houses the modulator and power conversion equipment.

The cubicles employ a novel form of construction, the design philosophy being to use the smallest number of units consistent with the ability to manufacture, pack, transport and install them without embarrassment due to size, weight or handling facilities. The cubicles have been designed to permit transportation with the majority of the components in situ.

The cubicle is constructed with a base frame made of heavy channel section steel which is welded at the corners and cross-braced to form a rigid plinth. Tubes are welded between the side channels to strengthen the base frame and to provide a means for moving the unit with the aid of rods and rollers.

A framework made of tubular steel members is bolted to the base frame to provide the strength and rigidity essential in a cubicle of this size. The free fixtures are used to support mountings for components and the external cladding. The fixtures are locked to the tubes by hexagon socket grub screws, and where greater strength is needed hexagonal pins are fitted through fixture and tube.

The base frame is covered by a heavy section alloy sheet, which provides radio frequency shielding, in addition to a flat surface braced to carry the heavy components.

Essential metalwork such as the centrally disposed air ducts and screens are built into the cubicle using the fixtures and tubework for location. One of the cubicles is shown in a partly assembled state in Fig. 3. This shows part of the external panelling in position illustrating the method of fixing the sheetmetal work to the tubular framework and base.

(* The Marconi Company Limited, Chelmsford, England.)

The external panels and doors are identical in construction to those used on previous Marconi transmitter designs. In addition the benefits of previous development work on cubicle construction methods relating to air sealing, r.f. screening and interlocking have been maintained in the larger basic units. For large equipments this form of cubicle construction shows great benefits.

Construction of Radio Frequency Amplifier Unit

This unit mounts the three radio frequency amplifiers with a layout up to the anode of the valve in the final stage as shown in Fig. 4.

The first r.f. amplifier is mounted on a sub-chassis on the right-hand side of the unit and the circuit "flows" smoothly towards the final r.f. amplifier on the left-hand side. The essential meters are built into appropriate points in the circuit and all tuning controls are disposed on the central control pillar. The preset controls for the third harmonic resonators, in anode and cathode circuits of the final r.f. amplifier, are mounted on the facia panel.

The rear half of the cubicle contains the large components associated with final r.f. amplifier anode tank and feeder coupling circuits.

Construction of the Modulator and Power Supplies Unit

This contains the modulator in the front half and the power conversion equipment in the rear section.

The modulator is illustrated in Fig. 5. The audio amplifiers are arranged on the panel in front of the air duct and the circuit "flows" from top to bottom to the grids of the two air-cooled modulator valves. The feedback potentiometers are fitted above the modulator valves to give the most direct connection to the first audio frequency amplifier.

The operational controls, overload indicators and test facilities are built into the central control pillar. The handles for the earthing switch and the key interlock device are mounted on the facia panel.

The power conversion equipment is mounted in the rear section of the unit, including the main h.t. rectifier which employs six excitrons type AR63 with a separate blower to cool the cathodes. All other d.c. supplies use air-cooled selenium rectifiers.

Radio Frequency Circuits

Three radio frequency amplifiers are used to raise the input drive power of 1 W to an output of 50 kW with 100% anode modulation. The block schematic, Fig. 6, shows the relationship of these amplifiers to the whole transmitter, and Fig. 7 shows the simplified diagram of the r.f. amplifiers.

The final r.f. amplifier uses one triode type BR1151 operating as a high-power, high-efficiency amplifier. The basic research work leading to the exploitation of this system was carried out by Mr. V. J. Tyler, whose paper in The Marconi Review[2] clearly outlines his work and presents a number of possible circuit arrangements.

For many years the Class C amplifier has been the most

Fig. 4. Front view of R.F. unit

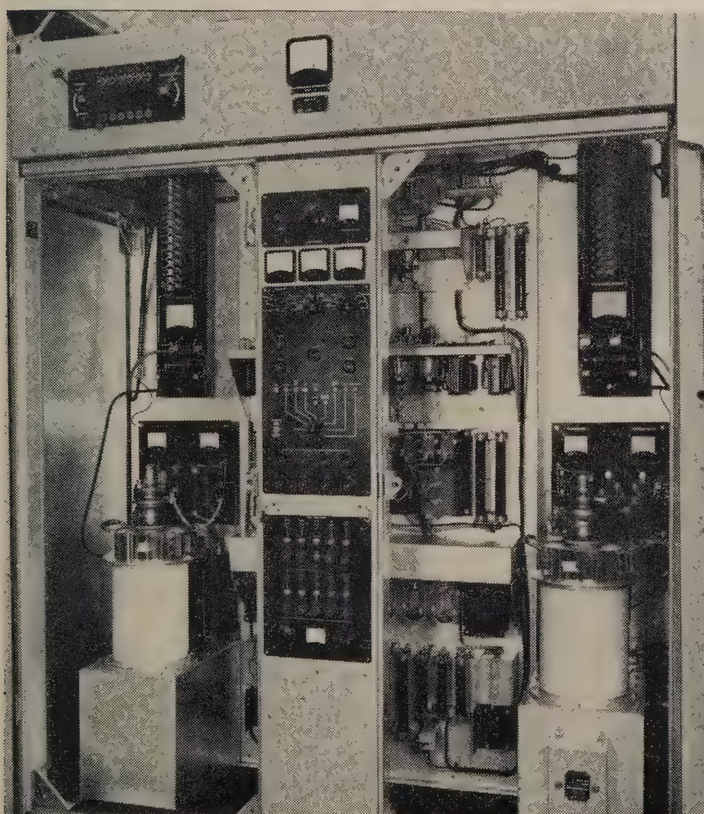
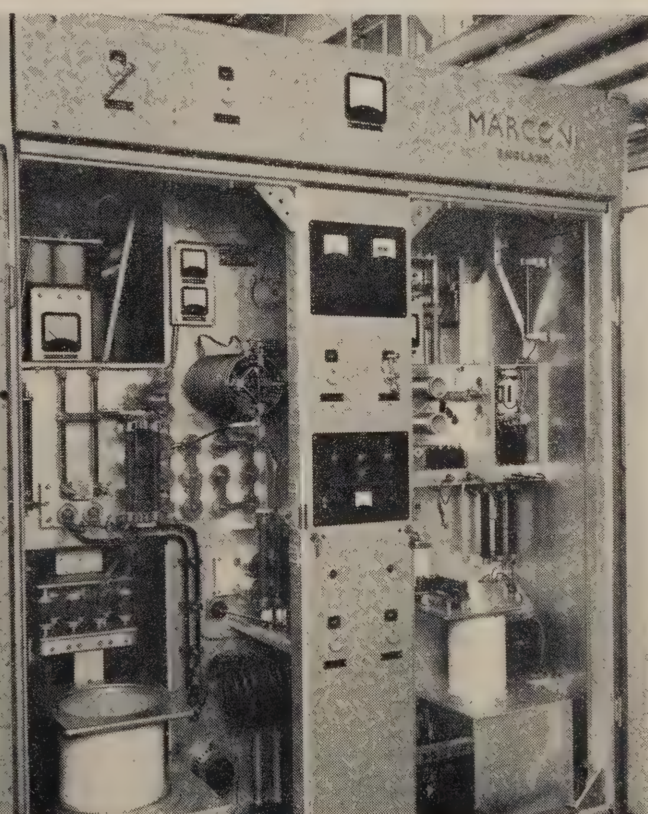


Fig. 5. Front view of modulator



efficient means of generating radio frequency power. It is therefore the standard to use when assessing an alternative system.

The Class C amplifier is driven from a sine wave source to produce a pulse of anode current I*ai* in Fig. 8a, and its relatively high conversion efficiency is dependent upon this current flowing during the period when the anode to cathode voltage bc is low. Since the anode voltage V*ai* in Fig. 8a is sinusoidal in form the anode loss P*ai* varies instantaneously around the crest voltage, the efficiency (N*ai*) being greatest at the crest and falling as the anode/cathode voltage rises. Clearly, if the anode current can be passed through the valve with the anode/cathode voltage maintained at the equivalent of the crest value of the sine wave over the full conduction period, the conversion efficiency will be maximum throughout that period.

The high efficiency amplifier approaches very closely to this ideal and the development of the system has been largely directed towards the exploration of the simplest circuits which will give the desired waveforms.

This transmitter employs a third harmonic resonator in the anode circuit of the final r.f. amplifier to produce the anode voltage waveform of V*ai* of Fig. 8b. The amplifier is driven from a sine wave source with a third harmonic resonator connected between cathode and earth to produce a rectangular pulse, 120° in length on the time scale, which will produce a similar pulse of anode current I*ai*. The instantaneous anode loss P*ai* varies over

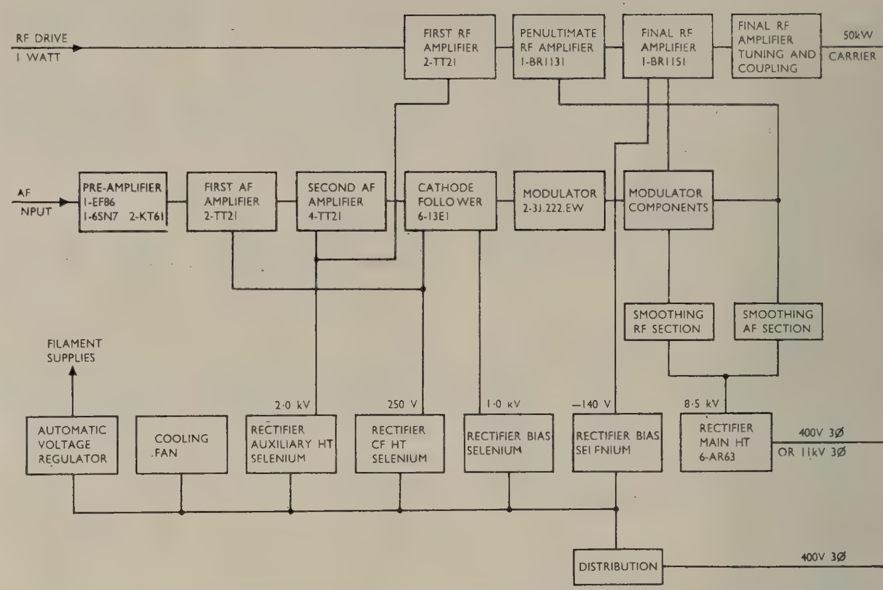


Fig. 6. A Schematic block diagram showing the relationship of the three radio frequency amplifiers to the transmitter as a whole.

the cycle, but the average loss is not significantly higher than that produced by an ideal waveform. In consequence the conversion efficiency achieved with this relatively simple arrangement closely approximates to the maximum obtainable with more sophisticated circuits.

The anode waveform realized on the 50-kW transmitter is reproduced in Fig. 9a for comparison with the theoretical waveform of Fig. 8b. To maintain conversion efficiency over the modulation cycle it is necessary to maintain the waveform relationships at all amplitudes. This is achieved on the 50-kW transmitter, and Fig. 9b shows the anode waveform with 70% tone modulation applied to the transmitter.

Reference to Fig. 8 shows that the valve conversion efficiency depends upon the ratio ab to ac. Since bc is largely fixed by the valve characteristics, the conversion efficiency rises as V (anode h.t. d.c. voltage) rises. However, conversion efficiency is not the only criterion of a good transmitter and the anode h.t. d.c. voltage on this transmitter has been kept to as low a value as possible. With an anode voltage of 8.5 kV d.c. the anode conversion efficiency has been measured to be 92%. Thus, allowing for circuit losses, the output of 50-kW carrier (to feeder) is obtained with a d.c. input of 56.5 kW and an anode loss of 4.5 kW.

The final r.f. amplifier anode circuit operates with a high loaded Q value, and is tuned by a variable pressurised nitrogen-filled capacitor. Inductive coupling is used to the feeder tank circuit, and sufficient variation of coupling is incorporated to couple into feeder impedances between 220 ohms and 300 ohms. The output can be reduced to approximately half power by adjusting the coupling.

The penultimate r.f. amplifier employs a forced air-cooled triode type BR1131 operating in Class C, with its output matched to the grid of the final r.f. amplifier by a π coupler. The grid circuit of

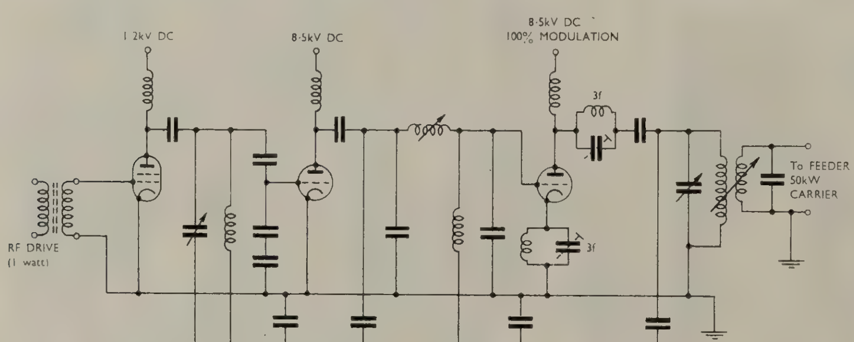


Fig. 7. A simplified circuit diagram of the r.f. amplifiers.

the final r.f. amplifier uses a high Q circuit resonated at the fundamental frequency in shunt with the output of the π coupler. This circuit supplies with negligible distortion the peak grid current demanded by the valve in the final r.f. amplifier.

Experience has shown that the tuning of a high-efficiency radio frequency amplifier can be effected as readily as the same operation on a Class C stage. The setting of the third harmonic resonators is effected using normal tuning methods and meter indications with no external monitoring. No critical adjustment is demanded and operation of the tuning controls produces a logical reaction from the transmitter.

Modulator Circuits

An input of 1 mW in 600 ohms is needed to give 100% modulation. This signal is applied to a pre-amplifier which is transformer-coupled to the first a.f. amplifier.

The second a.f. amplifier uses four tetrodes type TT21 in a parallel push-pull circuit to provide adequate voltage at the correct impedance to drive the main modulator valves via the cathode followers.

This latter stage uses six tetrodes type 13E1, which have excellent characteristics, to operate efficiently as cathode followers from an anode supply of only 250 V d.c. The valves are tetrode connected with series resistances to screen grids and Zener diodes connected from screen grids to cathodes. This arrangement maintains tetrode operation over the full anode/cathode voltage excursion.

The main modulator uses two forced air-cooled triodes type 3J/252EW in a push-pull Class B amplifier. Under normal operating conditions potentiometers connected to the anodes of these valves apply 16 dB of feedback to the grids of the first r.f. amplifier. For test purposes feedback can be removed or an additional 6 dB can be applied. The modulator output circuit comprises a transformer, reactor and capacitor proportioned to operate as a π circuit at both high and low audio frequencies. This presents a substantially resistive load to the anodes of the modulator valves resulting in little change of anode current at full modulation over the full audio frequency range.

Power Supplies

All valve filaments are lit by a.c. The filament structure of the BR1151 has been specially designed to produce low hum levels and enables a noise level of –66 dB to be achieved without the application of hum feedback.

The bias and auxiliary h.t. supplies are derived from rectifiers using selenium elements. Miniature circuit breakers are used for primary protection of filament and auxiliary h.t. supplies.

The main h.t. rectifier uses six mercury pool excitrons type AR63 in a 3-phase full wave bridge-connected rectifier. A "three shot" overload protection system is used to remove the h.t. d.c. voltage by "grid blocking" the rectifier tubes. Two attempts are made to restore h.t., and if the fault persists the h.t. circuit breaker is then tripped.

The controls are arranged on the central pillar and supplies can be applied in sequence automatically or manually as desired. Alternatively the transmitter can be started remotely by closing a single contact.

Air Cooling

At this power level, with high-efficiency operation, forced air cooling shows advantages when compared with water or evaporation cooling. The low losses, inherent with high-efficiency amplifiers, call for a very modest flow of air to give effective cooling.

The valves in the main modulator, final and penultimate r.f. amplifiers are forced-air cooled. In addition, localized air cooling is applied to selenium rectifiers and the cathode follower valves by pipes connecting to the central air ducts.

The air ducts extend to the full height of the cubicle and air can be extracted from the top or bottom to suit installation requirements. An air flow of 2600 cu. ft. per minute at a water gauge of 3.5in. is needed to cool the whole transmitter when used in a temperate climate.

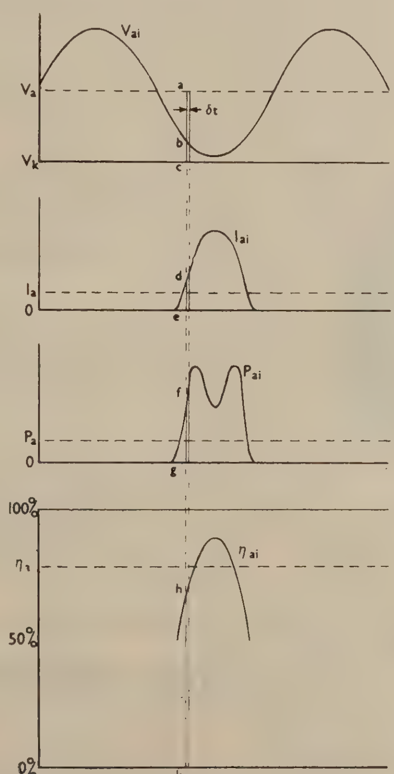


Fig. 8a. Waveforms of Class C amplifier.

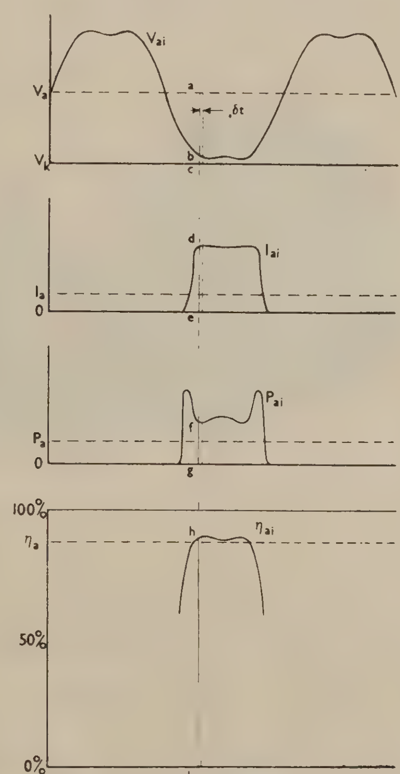


Fig. 8b. Theoretical waveforms of high efficiency amplifier.

Air is admitted to the cubicles from overhead ducts connected to the tops of the units. This ensures that the cooling air "scavenges" the cubicle before being sucked through the radiators on the valves to the exhaust duct.

A separate small blower is mounted in the roof of the power supplies unit to direct cooling air onto the cathodes of the six excitrons, type AR63.

Installation

The small size of the transmitter facilitates installation in existing or new buildings. No floor ducts or plinths are needed and all cooling and cabling connections are carried in an overhead tray to the top of the transmitter.

In the transmitter hall one unit is installed external to the transmitter. This houses the automatic voltage regulator for filament supplies, a by-pass switch, the mains isolator switch and the starter and timing device for the cooling fan motor. Auxiliary contacts on the isolator switch can be used to operate a red/green safety lamp system.

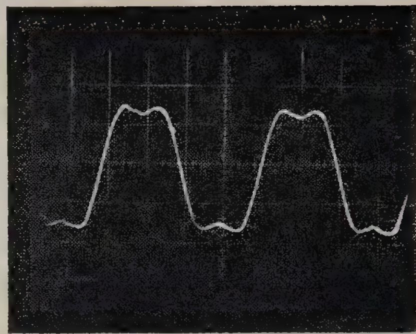
The transformers and associated oil-filled components are housed in a separate room to facilitate the fitting of CO_2 equipment.

A suction fan of the axial flow type is used. This simplifies the ductwork, and the use of efficient acoustic silencing sections ensures a very low noise level in the transmitter hall.

Paralleling

The use of two transmitters, paralleled by a Bridge T network,[3] produces an equipment of really exceptional reliability. The Bridge T network in a practical form introduces some 40 dB of isolation between transmitter outputs. Thus a fault on one transmitter has no influence on the other, and continuity of service is assured. Similarly, the control circuits of the two transmitters are entirely self-contained, again adding to the inherent reliability of the complete equipment.

These transmitters can be operated in parallel pairs, and certain design features have been incorporated to minimize the quantity of ancillary equipment.



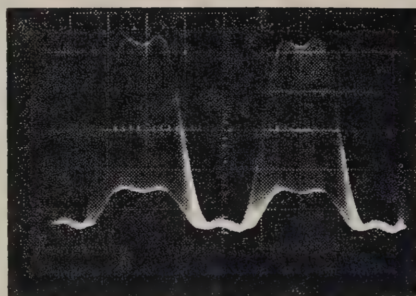


Fig. 9a (top): Practical Anode waveform, high efficiency amplifier (carrier).

Fig. 9b (bottom): Practical anode waveform, high efficiency amplifier (70% modulation).

Each transmitter needs a drive input power of 1 W. Thus a pair of transmitters can be operated with adequate drive power from a drive unit with a nominal output of 5 W. Phase adjustment is effected by varying the tuning control of the first r.f. amplifier in the transmitter. An adequate range of adjustment is obtained without disturbing the operating conditions of the rest of the transmitter.

For this application the parallelling components are mounted in a cubicle of the same construction and size (6ft. 6in. x 6ft. 6in. x 7ft. 2in. high) as those used on the transmitter proper.

The operating condition of the transmitters is determined by a manually operated four-position switch. This provides the unambiguous selection of:

1. Transmitters paralleled to outgoing feeder.
2. Transmitter A to feeder; transmitter B to test load.
3. Transmitter B to feeder; transmitter A to test load.
4. Outgoing feeder earthed for access to cubicle.

The Bridge T network includes an air-cooled resistance which is cooled by running a single stage of the externally mounted axial flow fan. When testing a transmitter the same load is used, but the cooling air flow is increased by running the second stage of the fan.

The relative phase of the two transmitter outputs is indicated on both transmitters. This indication is obtained by measuring the current in the resistive arm of the Bridge T network, which becomes a minimum when each transmitter output is equal in amplitude and phase.

Transmitter Performance

1. Frequency range: 525-1605 kc/s.
2. Power output (to feeder): 50 kW carrier.
3. Rating: 40% modulation continuously and 100% modulation for 10 minutes per hour.
4. Output impedance: 220 to 300 ohms unbalanced.
5. R.f. harmonics and spurious radiation: Less than 50 mW.
6. A.f. response:
   ± 1 dB 50- 7,000 c/s at 75% modulation.
   ± 2 dB 30-10,000 c/s at 75% modulation.
7. A.f. harmonic distortion: From 100-4,000 c/s not greater than 1.5% at 50% modulation, 3.0% at 90% modulation. From 30-100 and 4,000-10,000 c/s not greater than 2.5% at 50% modulation, 3.5% at 90% modulation.
8. Noise level: –60 dB unweighted relative to 100% modulation.
9. Power consumption: Carrier 80 kW, 30% modulation 90 kW, 100% modulation 116 kW.
10. Power factor: Better than 0.9.

☆

References

1. British Patent Specifications 783124 and 822209.
2. V. J. Tyler: A New High-Efficiency High Power Amplifier; Marconi Review, Vol. XXI, p. 96, 3rd Quarter, 1958.
3. W. J. Morcom: Operation of Transmitters in Parallel; Sound and Vision Broadcasting, Vol. 2, No. 1, p. 20 Spring, 1961.

A Transistorised Communication Receiver for Mobile or Home Station Use

Continued from page 18

current demand of the Class B power transistors will cause fluctuations in voltage with varying signal. This would react back on the oscillators if no regulation was included.

The R.F. gain control merely controls the gain of the receiver by varying the forward bias on the controlled stages when the A.V.C.-R.F. gain switch is in the R.F. gain position. This control is rarely used, and the A.V.C.-R.F. gain switch could well be a S.P.D.T. switch ganged onto the R.F. gain control potentiometer if this is available. The author managed to locate some of Italian origin which had this facility. Otherwise a separate switch will be required. Another suggestion is to use a multi-contact mode control switch and have four positions for A.V.C. with B.F.O. on; A.V.C. with B.F.O. off; manual gain, B.F.O. on; manual gain, B.F.O. off; etc.

The muting switch follows the main power on/off switch and controls all the receiver except those parts fed by the series regulator transistor. This enables the receiver to be muted, for example during transmission and yet does not cause oscillator drift.

Construction

The author constructed the receiver in two sections, the R.F., Mixer, and tunable oscillator stages, which were mounted on a metal platform or sub-chassis, and the remainder, which was fabricated on a single piece of Formica laminate, with silver plated eyelettes punched in at appropriate places, for the mounting of components.

Ideally, this receiver could be built as a printed circuit board. However, the first receiver was built in a simple manner so as to allow for development, and whilst operating this receiver, some development is still continuing.

The R.F. and Mixer coils are wound on a $\frac{1}{4}$in. O.B.A. Slug tuned formers with aluminium shielding cans. These are mounted alongside the tuning condensers. The I.F. detector and audio system is mounted on a single piece of paxolin, with the I.F. progressing down one side, and the detector, A.V.C., and audio up the other. The output transistors and regulator transistor, and output transformer were also mounted on the metal sub-chassis. This provided a heat sink for the three transistors which were dissipating power.

Next month we will give details for coils to cover 3.5 to 5 megacycles and also a method for calculation of padding capacities to use with a given variable capacity to cover a desired tuning range. (To be concluded.)

Serviceman's Column

Continued from Page 23

The correct colours went to the correct terminals, but I still wasn't satisfied. A really close look through a magnifying glass revealed that the centre-tap and one outer lead had been transposed right at the point where they emerged from the winding! As if servicemen haven't got enough to contend with without getting sneaky faults like that in new components. Wouldn't it make you spit?

I didn't bother to correct the fault "internally" but just reversed the appropriate external connections and everything in the garden was lovely.

If there is any moral to be learned from this little story it is this—don't use your VTVM to measure peaky waveforms, at least not unless you use your 'scope as well.

* * *

A SCURRILOUS CONTRIBUTION

By ANON.

I had occasion a few months ago to champion the cause of better service for orphan receivers. Many of these have been brought back quite legitimately by overseas travellers. A friend of mine brought round a transistor 6, bought in Singapore for a fiver. It was distorted and signal output weak since being dropped.

He repaired the cabinet by the use of thick aluminium foil with an adhesive, found by trials to be solvent for the particular plastic powder which had gone into the case. I wore out a set of tyres and toe plates in the search for a replacement speaker. Finally, after being offered one speaker only, and at 25/-, we wrote to the manufacturer. Within days a new and improved replacement arrived by airfreight. The manufacturer apologized that he would not be making any charge as the documentation was more expensive than the ex-factory value of the speaker.

My pet hate is the use by manufacturers who should know better of fastenings for which special tools are required. The fork-prong type screwdrivers needed to remove collars on some irons are a case in question. Can anyone tell me where these tools are available? Long-nose pliers and penetrating oil are not more than 98% substitute.

We are sometimes asked to give an opinion on how long a radio should be kept in service. I traded in a 5-valve Radion recently for 10/-. It was terribly distorted and the power cord quite perished. Before sending it to the tip an inspection was made to see what could be salvaged. Under chassis the wiring was a joy to behold. Woven braid covered the wires

Continued Overleaf


COLD LOGIC
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so that the loss of insulation apparent on the power cord did not make the internal wiring hazardous. A new plastic mains cord was quickly fitted.

Great distortion. Positive grid voltage on the output valve. New coupling condenser. Sweet music. This model has a solid timber laminate cabinet with a very old-fashioned 5in. E.M. speaker. It sounds clean although frequencies are mostly missing at many points of the spectrum. This set found its way into the nursery. Last night 2YX, which carries the long-hair programme when the bald heads are elsewhere, was smothered with ZKF which has a broad-band MCW transmission.

We took the Radion into our room as it was able to reject the MCW and still accept the Mozart. It is a horrible looking set but I suspect it is there to stay. It is a credit to the valve distributors that the valves used in this set, 42, 80, 6B7G, 6A7G, 6D6, are all available. Is this because, with the exception of the 42, all the originals are still functioning? With the regular rise in valve replacement prices these stocks of old tubes must be a gilt (guilt) investment.

AERONAUTICAL EXPERT SPEAKS ON NOISE

A recent visitor to this country, Professor Richards of Southampton University, gave a paper to the Auckland Branch of the Royal Aeronautical Society entitled the Subjective Assessment of Aircraft Noise. This was given before an audience of over 100 on 8th August at National Airways Centre and dealt firstly with human hearing and the scales of measurement used before passing on to the subject proper. The difficulty, Professor Richards said, was that noise effects on the human could not be read on a meter; what was acceptable to one could be annoying to another. He described the social surveys carried out in London to determine householders' reactions to their surroundings — noise was only a part of survey questions, so that the answers received were not "loaded" against noise.

A direct scale of dB's could not be used in aircraft noise problems so a new unit, the perceived noise dB, PNdB, was used that took into account the spectrum of the noise. Human reaction is due not only to the noise level but to the number of times per day that it occurred. This factor had caused the introduction of the Noise and Number Index (NNI) that correlated, say, a few noises of high intensity against a greater number of medium intensity. The use of NNI allowed contour maps to be used to map the probable noise patterns from airports.

To keep airport noise at current levels but to allow for the 4 or 5-fold increase in traffic in the next 10 years or so a 9dB reduction would be needed to be made in aircraft noise. Some of this would come about with better jet engine design and some by better take-off and landing techniques. The problem of high landing noise due to the compressor was currently being tackled by leading manufacturers and research institutes.

—W.L.

ENQUIRY CARD AD. 17

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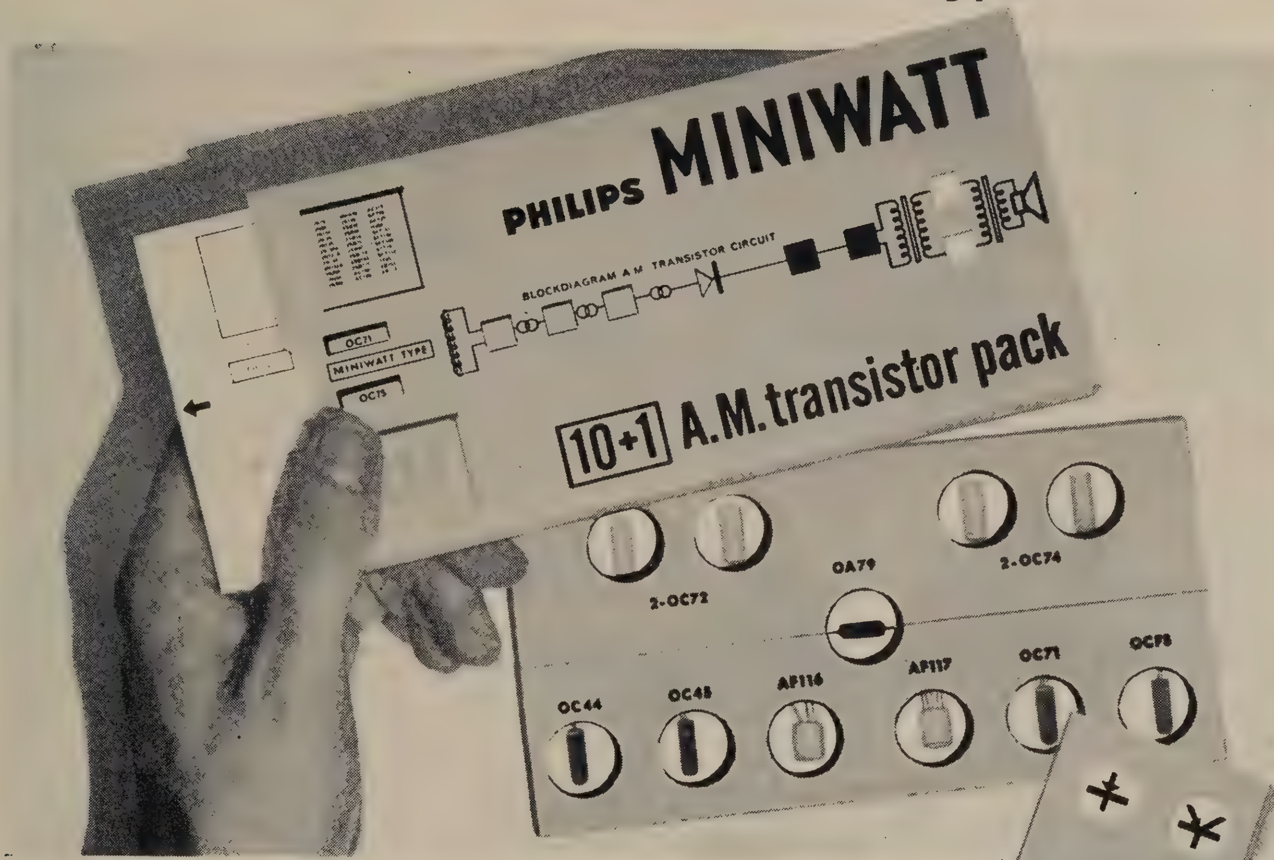

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ENQUIRY CARD AD. 18

Advance power supplies

Power Supply Unit PP1

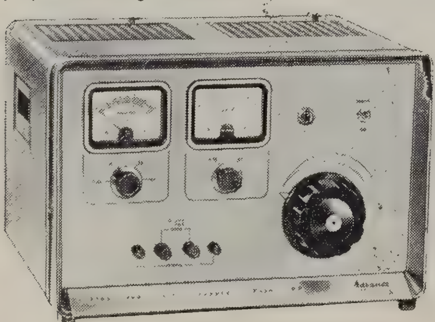
Input voltage 94 to 138V, 187 to 276V, 50c/s only. *Outputs*

Supply No.	*1*	*2*	*3*	*4*	*5 and 6*
Voltage	0 to 600V DC	+100 to +800V DC	−200V DC fixed	0 to −200V DC	6·3V AC (r.m.s.)
Maximum current	300mA total	300mA total	50mA	5mA	4A each
Maximum source impedance (ohms)	0·1 (DC) 0·5 (at 50kc/s)		0·1 (DC) 0·3 (at 30kc/s)	13K	
Maximum ripple voltage (r.m.s.)	3mV	3V	1mV	1mV	
Stabilisation factor within permissible mains variation	1000 : 1	4 : 1 essentially unstabilised	1000 : 1	1000 : 1	15 : 1
Short circuit protection	e.m. cut-out	e.m. cut-out	100MA fuse F.3		Stands brief short circuits

Special features *Variable source impedance* Source impedance of supply No. 1 variable from 0·1 to 40Ω. *Artificial ripple injection* (a) *Internal* 50c/s up to 6V. (b) *External* Up to 50kc/s from external generator working into 5Ω load. *Metering* Two meters are fitted. *Dimensions* 19¾in (50cm) wide × 13 in(33cm) high × 15in (38cm) deep. *Weight* 92 lb (42kg).

Power Supply Units PP2 PP4

Input voltage 100 to 125V, 200 to 250V, 50c/s only. *Output voltage* PP2 0 to 50V d.c., PP4 0 to 80V d.c. both continuously variable. *Current* PP2 0 to 10A, PP4 0 to 6A. *Impedance* Less than 0·25Ω up to 100kc/s (4-terminal output provided). *Resistance* Less than 0·003Ω. *Stabilisation* Input voltage variations of ±15% are permitted, stabilisation factor 5000: 1. *Ripple* Less than 2mV pk.pk. *Metering* Two meters are fitted.



PP2

PP2 Ammeter switched in four ranges as follows 0 to 0·3A, 0 to 1A, 0 to 3A, 0 to 10A. Voltmeter switched in two ranges as follows 0 to 6V, 0 to 60V.

PP4 Ammeter switched in four ranges 0 to 0·2A, 0 to 0·6A, 0 to 2A, 0 to 6A. Voltmeter switched in two ranges 0 to 10V, 0 to 100V. *Overload protection* Resettable cut-out operates when load current exceeds 125% of ammeter F.S.D.; cut-out occurs within 0·2ms of the overload. A thermal cut-out provides protection against excessive internal temperatures at maximum load. *Dimensions* 20¼in (51·4cm) wide × 13¼in (33·6cm) high × 16¼in (41·3cm) deep. *Weight* 140lb (63kg).

Power Supply Unit PP3

Input voltage 90 to 130V, 200 to 240V, 40 to 60c/s. *Output voltage* 0 to 30V d.c. in three ranges, 0 to 10V, 10 to 20V, 20 to 30V. *Current* 0 to 1A. *Impedance* (d.c.) Less than 0·01Ω. *Impedance* (a.c.) Less than 0·2Ω up to 100kc/s. *Ripple* Less than 0·5mV pk.pk. *Stabilisation* 7% supply variation varies output by approximately 10mV. *Metering* An ammeter and a voltmeter, switchable to either output. The ammeter has two ranges 0 to 0·1A F.S.D. and 0 to 1A F.S.D.

Overload protection Resettable electronic cut-out. *Operating temperature* Up to 35°C (ambient). *Dimensions* 18in (46cm) wide × 13¼in (33·5cm) high × 11½in (29cm) deep. *Weight* 38lb (17·25kg).

A Rack mounted version is also available—PP3R.

Power Supply Unit PP6

Input voltage 110, 120, 220, 240V ±15%, 50c/s only, 160W each section. *Output voltage* 0 to 30V in six overlapping ranges. *Current* 0 to 3A at any output voltage. *Impedance* (d.c.) Less than 0·02Ω; (a.c.) less than 0·2Ω up to 100kc/s. *Ripple* Less than 1mV pk.pk. *Stabilisation* 3000: 1 permits supply variations of ±15% above and below nominal value. *Metering* Two meters are fitted. An ammeter 0 to 0·1A, 0 to 0·3A, 0 to 1A and 0 to 3A F.S.D., and a voltmeter 0 to 30V. *Overload protection* Resettable electronic cut-outs adjusted to operate at 125% of F.S.D. on any current range. *Operating temperature* Up to 35°C (ambient) at full load.

Dimensions 20in (50·7cm) wide × 13in (33cm) high × 15in (38cm) deep. *Weight* 70lb (31·8kg).

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ENQUIRY CARD 2

* * *

NEW CHARACTER DISPLAY TUBES FROM FAIRCHILD'S DU MONT LABORATORIES

Increasing emphasis on design and development of a wide variety of character display tubes by Fairchild's Du Mont Laboratories is evidenced by the announcement of type K2230, a 5-inch diameter projection tube capable of .0027 inch maximum line width at 1,000 ft. L. brightness on a 60.0 square cm raster when operating the special P4 screen at 27 Kv.

As in many Du Mont high-resolution character tubes, the characters in the K2230 are formed by means of electrostatic character plates in a magnetic deflection tube.

Character or symbol generation is incorporated in a wide variety of applications including computer read-out, contact or projection printing, traffic control, map and target identification, coding and projection displays.

ENQUIRY CARD 4

* * *

HALL GENERATORS AVAILABLE FROM WESTINGHOUSE

A line of Hall generators is available in a wide range of voltages and types from the Westinghouse Semiconductor Division. These semiconductor devices linearly multiply magnetic field and device current to produce an output voltage. Hall generators can be used as gauss meters, ammeters, wattmeters, function generators, choppers and position indicators.

The series of generators comes in voltage classifications from 210 to 420 millivolts in a ten-kilogauss field. Linearity is held to be one per cent with moderate temperature coefficients. The units are epoxy encapsulated and have dimensions of 0.375 x 0.375 x 0.023 inch. One 225-millivolt unit is an 0.55 x 0.05 inch-thick disc.

For precise measurements of magnetic fields, there is a ceramic-encased unit with linearity of 0.2 per cent. and moderate output. It measures 0.60 x 0.32 x 0.06 inch.

For position indicators and contactless switches, there are three thin-film devices with high Hall voltage outputs of 1.7, 1.5 and 1.1 volts.

ENQUIRY CARD 8

* * *

NEW MICROWAVE SWITCHING TUBE DEVELOPED

An externally controlled mirowave switching tube, called a "tail-clipping" tube, has been developed for use on systems requiring clean and sharp transmitter pulses by the Westinghouse Electronic Tube Division.

The WX-5303 tube reduces both the pulse fall time and the output pulse width. The fall time of the transmitter pulse can be decreased to about 15 nanoseconds. Since the tube is externally triggered, it can discharge at any selected time during the transmitter pulse.

Designed for the 9.0 to 10.0-gigacycle frequency range, the tube operates over any 100-megacycle band within this spectrum as specified by the user and provides 15 dB attenuation within 15 nanoseconds after the trigger voltage is applied.

Other operating characteristics include: 0.4-decibel insertion loss; 80-kilowatt r-f peak power; and trigger spike of 2 kilovolts.

ENQUIRY CARD 9

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NEW PRODUCTS—*Continued*

MOLECULAR ELECTRONIC RADAR DEVELOPED BY WESTINGHOUSE AEROSPACE DIVISION

A semiactive doppler radar that uses molecular electronic functional blocks for all the receiver and signal processing circuitry has been developed by the Aerospace Division of the Westinghouse Defence and Space Centre.

Called Modor (Molecular Doppler Radar), the new unit operates at X-band frequency. It has a sensitivity of —110 dbm (decibels below one milliwatt) and a velocity track bandwidth of 5 kilocycles.

The two types of developmental blocks used are the Lava and Mirt blocks. The Lava is a universal linear block containing the equivalent of six transistors, two field effect devices, four diodes and 18 resistors on a single, double-diffused, planar passivated silicon substrate. The Mirt is a linear block designed for extremely high d-c isolation and extremely low power operation. It contains the equivalent of a transistor with all the necessary bias resistors and diodes for temperature-stabilised operation.

The only nonmolecular devices used in Modor are the solid-state local oscillator built by Western Microwave Laboratories and the planar array antenna built by Rantec Corporation.

The receiver subsystem of the Modor has two 30-megacycle pre-amplifiers, a 10-megacycle offset oscillator, a 40-megacycle filter amplifier, and a 10-megacycle signal i-f amplifier. WM-1106 molecular block ampliers and etched functional circuit tuning boards permit all i-f functions to be achieved with only 45 discrete components.

The signal processing circuitry, consisting of the velocity track loop, the automatic gain control loop, and the velocity search and detection unit, uses the Lava and Mirt blocks for all gain functions. This circuitry has a total of 75 discrete components.

A molecular drift field tuning technique, developed by Westinghouse Aerospace, is used in the radar's velocity track filter and discriminator and in its variable-frequency oscillator. The technique requires only two functional silicon substrates to provide either a voltage-controlled oscillator or a tuned amplifier.

Studies on Modor indicate that all electronic and microwave functions exclusive of the servomotors and the rate gyros, can be packaged in total volume of two by two by six inches. The electronic package, less antennas, will weigh between 1¼ and 1½ pounds.

Although the size and weight reductions demonstrated by Modor are significant, the principle advantages of the Modor design are major improvements in reliability and major reductions in production and maintenance costs. These improvements result from the use of molecular electronic functional blocks and compatible etched circuit functional tunning boards to reduce the number of discrete components required.

ENQUIRY CARD 11

* * *

MIDGET AMPLIFIER DEVELOPED BY WESTINGHOUSE AEROSPACE DIVISION

A miniature amplifier has been developed by the Aerospace Division of the Westinghouse Defence and Space Centre for use in aerospace radar and communications systems work.

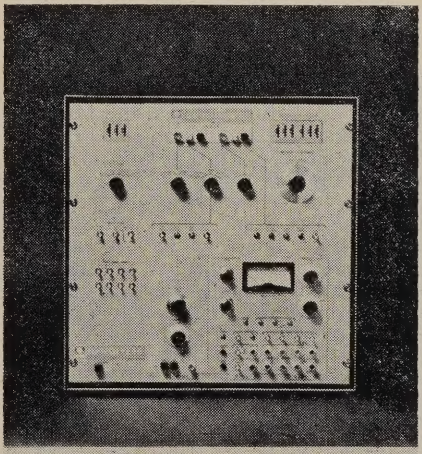
Built for high reliability, the 60-megacycle bandpass intermediate frequency amplifier measures ⅜ by ⅜ by ¾ inch and weighs 4.3 grams. It uses 18 milliamperes of current at a voltage of 12 volts dc.

The unit's over-all bandwidth is 8.7 megacycles and its over-all gain is 42.5 decibels. Four synchronous, single-pole bandpass networks provide the frequency selectivity.

The new amplifier is made with molecular electronic functional blocks and welded modular construction for high-density electronic packaging.

Each individual stage of the unit is shielded for electro-magnetic isolation.

ENQUIRY CARD 12



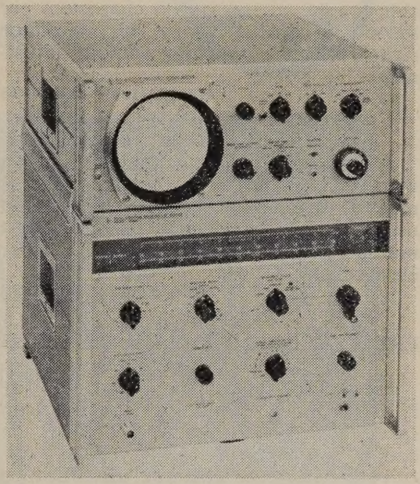
NEW 10 NANO-SECOND PER CHANNEL MULTI-CHANNEL ANALYSER

Developed by Radiation Instrument Development Laboratory

A 256 channel thin film memory analyser (Model 34-26), which operates approximately 50 times faster than conventional multi-channel analysers, has been introduced by RIDL.

The ultra fast memory and 100 megacycle nuclear physics oriented ADC permit experiments whwich were previously impractical with available multi-channel analysers. Ten to fifty times the number of pulses can be analysed in any given time period, thus permitting a great savings in valuable accelerator operating time. Analysis of extremely short half lives and short burst activity is practical because many more pulses are processed by the analyser.

ENQUIRY CARD 21



NEW SPECTRUM ANALYSER FEATURES 2 GC SWEEP, FULL CALIBRATION

2-gc bandwidth from 10 mc to 40 gc, accurately calibrated 60 db dynamic range, and sensitivity of &100 dbm are features of Hewlett-Packard Company's new Model 851A/8551A Spectrum Analyser.

Designed to give a large increase in the scope, speed, and accuracy of spectrum monitoring, spectrum signature identification, and RFI analysis, the entire instrument occupies only 19 inches of rack space, weighs less than 140 pounds.

By contrast with previous analysers, all basic functions are fully calibrated. Spectrum width accuracy is ± 5% from 100 kc to 3 Mc, ± 5% at Mc, and ± 4 Mc from 30 Mc to 2 Gc. Sweep rate may be set with 2% accuracy. Resolution is adjustable, manually or automatically, at 1, 3, 10, 100, or 1000 kc. Over the full 2 Gc. sweep, frequency response is better than ± 5 db. The vertical display is also calibrated: logarithmic response 60 db ± 2 db, linear 70:1 ± 3%, and square (power) 70:1 ± 5± 5%.

An important contributor to performance and operating convenience is a newly-developed rf attenuator which may remain constantly in the circuit without penalizing sensitivity, since it has zero loss at dc, and less than 2 db at 10 Gc.

Frequency response of the HP Model 851A/8551A is ± 3 db over the 2 Gc Sweep, and ± 1 db or better over 1 Gc. A built-in signal identifier determines the frequency of each response by identifying the harmonic of the internal oscillator with which it is beating. The frequencies can then be read from the appropriate dial scales.

The calibrated vertical range of the analyser may be set for linear, square (power), or logarithmic response.

ENQUIRY CARD 22

NEW PRODUCTS—*Continued*

High-Speed Tape Punch

A new high speed tape punch which can operate at up to 100 characters per second is capable of five, six, seven or eight-track tape punching without adjustment.

ENQUIRY CARD 26

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New Spark Erosion Machine

A new spark erosion machine has a work tank capable of taking pieces measuring 32 by 25 by 15 inches and uses graphite electrodes, said to last more than ten times as long as copper electrodes.

ENQUIRY CARD 32

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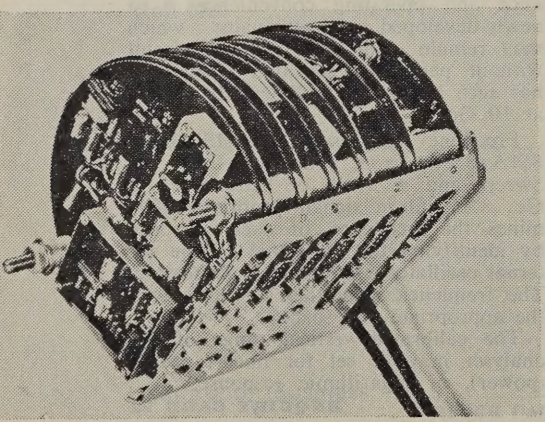
PRINTED CIRCUITS FOR BRITAINS SECOND SATELLITE

Electronic instruments carried by U.K.2, the second Anglo-American space research satellite, include an ozone spectrometer with printed circuits formed on copper-clad Formica industrial laminate. The instrument, made by the British Aircraft Corporation, is being used to determine the vertical distribution of ozone in the atmosphere by measuring the extent to which ultra-violet radiation from the sun is absorbed by ozone.

The Formica laminate is made by impregnating sheets of continuous filament glass fabric with an epoxide resin and pressing them together until they fuse into a homogeneous board. Copper foil 0.0015 inch or 0.003 inch thick is laminated to one or both surfaces and the printed circuit subsequently produced by etching.

The atmospheric ozone experiments together with experiments for measuring the flux of micrometeorites, occupy a cylindrical space 23 inches in diameter by about 9 inches deep in the upper half of the capsule. Each of the two ozone experiments observes in four directions, and the capsule makes two and a half rotations in the 30 seconds during which it is observing the sun through the ozone layer which surrounds the earth—the amount of absorption being a direct measure of the ozone concentration in the line of observation. Twenty observations in all are made.

ENQUIRY CARD 23



High-Speed Paper Counter

Sheets of paper of any size, printed or plain, are counted electronically at 4,200 per minute by a new British machine. The manufacturer has also introduced a machine that counts new or used banknotes of any size. It is smaller, cheaper and only half the weight of an earlier version.

ENQUIRY CARD 27

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Experimental High-Speed Computer for London Exhibition

A high-speed computer, which will form the basis of the next generation of computers to be produced by one British firm, was exhibited by them at the Instruments, Electronic and Automation Exhibition in London. (Olympia, May 25-30). This computer derives from air traffic control and military requirements and combines a number of advanced techniques to provide a desk size unit which operates at ten times the speed of computers of comparable complexity currently available. It has, therefore, ten times the potential on-line capacity.

ENQUIRY CARD 28

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New Electric Crane Featured at British Exhibition

A new three-ton overhead universal electric crane was shown for the first time by one British firm at the Mechani cal Handling Exhibition in London (Earls Court, 5th-15th May). It was of the double-girder type, with the hoist unit travelling on top of the bridge girders. The firm's range includes both single and double-girder types with combinations of bridge arrangement to accommodate special needs or circumstances, such as close lift or restricted headroom. The crane is operated from a multi-button control suspended from either the hoist unit or the bridge and the control circuits are all low voltage. Considerable emphasis has been placed on safety in the design.

ENQUIRY CARD 29

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Compact and Versatile Pulse Generator in New Style Solartron Pulse Generator GO.1101.2

One of the best known of the Square-wave and Pulse Generators manufactured by the Solartron Electronic Group Ltd., Farnborough, Hants., the Type GO.1101.2, now appears in a new packaging. Also several minor technical improvements are incorporated, one of which is that the lower end of the pulse duration range is now 1.0 microsecond instead of 2.0 microseconds.

This continuously variable instrument has proved to be an exceptionally compact and versatile signal source that pro vides, at an economical cost, all the facilities normally found in much costlier instruments.

It is indispensable for the investigation of fast switching circuitry and for the development of video amplifiers, modulators and filters.

In addition to the standard pulse output covering the frequency range 10 cycles per second to 500 kilocycles per second, the GO.1101.2 will also generate a square-wave signal over the same range.

The pulse shaping and output stages can be externally triggered to produce a square-wave signal of 0.5 to 100 volt amplitude, from a sine-wave or approximate square-wave input of any frequency between 25 cycles per second and 5 megacycles per second.

External synchronisation facility enables the instrument to be employed as an oscilloscope sweep delay generator or frequency divider.

Short Specification

Continuously Variable.
Period: 2 μsec – 100 msec in 5 ranges.
Pulse Duration: 1 μsec – 100 msec in 5 ranges.
Pulse Amplitude: 0.5V – 100V in 4 ranges.
Delay: 1 μsec – 10 msec in 4 ranges.

Single or double, positive or negative pulses less than 12 nanosec fastest edge.

The Solartron Electronic Group Ltd. is represented in New Zealand by E. C. Gough Ltd., Christchurch.

ENQUIRY CARD 30

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MICROMINIATURE CONDENSER MICROPHONE

Now available in New Zealand is the new P.M.L. miniature microphone and power supply. This is the smallest professional microphone of its class ever produced and has been widely used for the most critical professional applications while still remaining within the price range of the amateur recordist.

Specifications (Microphone)

Frequency Response: below 30 to above 18kc/s ± 3 db. Sensitivity: —52db (Model EK61) —50db (Model EC61). Directivity: 15db 85% approx. (for cardioid). Amplifying Tube: XFY54 HIVAC. Current Consumption: 10mA (Heater). 0.04mA (plate/polarizing). Size: 2 11/16in. length, 11/16in. dia. Weight: 1¼oz. Finish: Anodized Satin Chrome. Output Impedances: Choice 50, 200, 600 ohms or Hi-Z. Supplied with: 10ft. power supply cable, 10ft. signal cable (screened single coaxial conductor), clamp-on mike stand adaptor (5/8in. x 27 tpi).

Specifications (Power Supply)

Model No. 4315 — AC 110/125 V, 60 cycle. Size 4½in. x 2in. Weight: 1lb. 1oz.

Model No. 4316 — Battery- 1 -67½V, 1 -1.4V Mercury. Weight: 11oz. (batteries incl.).

Distributors: P. H. Rothschild & Co. Ltd., Lower Hutt.

ENQUIRY CARD 25

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